Expert Modeling in Argumentive Discourse

Lia N. Papathomas

Submitted in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy
under the Executive Committee
of the Graduate School of Arts and Sciences

COLUMBIA UNIVERSITY

2016

ABSTRACT

EXPERT MODELING IN ARGUMENTIVE DISCOURSE

Lia N. Papathomas

Educational standards increasingly emphasize argumentation skills as goals fundamental to academic success, but schools largely fail to develop these skills in students, particularly among those in educationally disadvantaged populations. The present study examines development of argument skills among disadvantaged middle schoolers by engaging them in dialogs with a more capable adult over the course of a school year, in the context of a twice-weekly argumentation curriculum. Over four successive topics, participants in the curriculum engaged in six sessions of argumentive dialog per topic. Dialogs were conducted electronically between a pair of peers holding the same position on the topic and successive peer pairs holding the opposing position. Students were randomly assigned to treatment and comparison conditions. For students in the treatment condition, unknown to participants (due to the electronic medium), for half of the dialogs the opposing peer pair was replaced by an educated adult. These alternated with dialogs with peer pairs. Students in the comparison condition participated only in peer dialogs. The adult model arguers sought to concentrate their input on advanced argument strategies, identified as Counter-C (critique) and Counter-U (undermine), to the maximum extent possible. Effects on students were evaluated by their performance in their peer dialogs over the year and in a final dialogic assessment on a new topic in which students argued individually with an opponent (rather than in collaboration with a same-side peer). By the second of four topics, the more advanced argument strategies began to appear in a greater proportions of utterances in the dialogs of students in the treatment condition, compared to those in the comparison condition.

The effect of condition increased over successive topics. It also persisted beyond the treatment context to the transfer task. These findings are suggestive of the power of engagement with a more competent other as a means of developing higher-order cognitive skills, as well as less complex social and cognitive competencies, where learning through apprenticeship has already been demonstrated to be a powerful learning mechanism. These findings are of particular significance for the educationally disadvantaged population studied here, who often are afforded inadequate opportunities to develop higher-order cognitive skills. Pedagogical and social implications are discussed.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

Because it truly took a village, I would like to thank:

Dr. Deanna Kuhn, for her mentorship, guidance and support, and especially for her vision for education, and dedication to inspiring students' intellectual curiosity.

My dissertation committee, for their thoughtful questions and feedback- especially Dr. Bryan Keller, as chair, for his invaluable input throughout each step of the process.

My fellow lab-mates and classmates, for the sense of academic community and friendship that allowed me to maintain my sanity and my focus, with a few laughs along the way.

My friends and family who checked in and encouraged me through challenging moments.

Alexander Papathomas - my brother, my best friend and confidant from the beginning, for reminding me that no matter how much I accomplish, I still have a lot of growing up to do.

Anthony DiIonno - my partner in life, my unwavering support and greatest motivator, for always pushing me forward, and for believing I could do this even before I did.

DEDICATION

To my parents, Thomas and Georgia Papathomas,

my foundation and my inspiration,

for giving me the roots to grow and the wings to fly.

To my grandmothers, Galatia Papathomas and Corina Nikolakopoulou

I could never be me without you.

CHAPTER 1

INTRODUCTION

In her autobiography, Supreme Court Justice Sonia Sotomayor claims that through a middle school debate curriculum, she learned “to pay attention for the vulnerable links in a chain of logic...mapping out a position, anticipating and addressing objections, and considering how to best persuade her listeners” (Sotomayor, 2013). Throughout her life story, Justice Sotomayor frequently credits her early experiences in argumentation with her later academic success and ultimate professional success, as she found that these skills proved critical in her ability to write and reason.

Consistent with Sotomayor’s personal experience, research shows a wealth of positive outcomes from learning and practicing argumentation which generally include more advanced reasoning (Kuhn et al., 2013), metacognition, and higher-order thinking (Kuhn & Crowell, 2011; Brown & Campione, 1990; de Leeuw & Chi, 2003), as well as deeper learning and better understanding of content (Nussbaum, 2008). As such evidence of its contributions to learning accumulates in educational research, argumentation has garnered a great deal of attention for this potential impact on students’ cognitive development.

The importance and relevance of argumentation is further reinforced by current standards in education, which explicitly set student goals based on a foundation of reasoning and argumentation skills. The Common Core State Standards Initiative, which seeks to establish learning goals for students to advance academically and prepare for college and the workforce, posits that “the ability to write logical arguments based on substantive claims, sound reasoning, and relevant evidence is a cornerstone of the writing standards...extending down into the earliest grades" (CCSS, 2012). Despite such emphasis, schools appear to fall short in cultivating and promoting this learning, as research documents weak argumentation skills in students (Kuhn & Wang, 2011). Findings suggest that students innately lack the skills required for successful argument, and that young adolescents' typical approach suggests a limitation not only in ability but also in understanding the goals and purpose (Kuhn, Wang & Li, 2011). Furthermore, current methods of teaching these skills in schools are largely ineffective (Kuhn et al., 2013) as evidenced by adolescent students' continued reliance on weak, unsuccessful strategies in persuasive writing and argumentation (NAEP, 2011).

The data show a very clear deficit in effective curriculum focused on argumentation, and a need for methods to implement this learning in schools in an impactful way. In a series of studies, Kuhn and colleagues design and study an argumentation curriculum centered around dialogic interaction to enhance development of argumentive thinking. Data from this research reveal that argumentive reasoning skills can, in fact, be developed (Kuhn & Crowell, 2011) and demonstrate significant positive outcomes for students, ranging from improved argumentation to better essay writing (Felton & Kuhn, 2001; Crowell & Kuhn, 2014; Kuhn & Crowell, 2011). Kuhn's curriculum builds on Vygotsky's (1978) sociocultural tradition and Kuhn's (1991) "everyday talk" to successfully engage student peers in collaborative, social learning. Studies of the curriculum have established the importance of this dialogic method in developing argumentation skills; however, there is still much to understand about how and why the social context facilitates student learning.

The present study seeks to further explore underlying mechanisms of development, from the constructivist perspective, specifically Vygotsky's (1978) "zone of proximal development," to examine the impact of dialogic engagement with an “expert” on students’ argumentation. Previous research demonstrates short-term effects of modeling of advanced strategy among pairs of students participating in an argumentation curriculum (Mayweg-Paus, Macagno & Kuhn, 2015). The present research aims to expand on previous findings by considering development of argument skill in an academically at-risk population. Better understanding of the ways that students acquire such skills will lay the way for further curriculum development and implementation in schools, to better ensure students’ acquisition of cognitive skills critical to future academic and professional success, and ultimately engagement in the world as productive citizens.

The potential for argumentation to act as a vehicle for facilitating higher-order cognitive development has long been established, but developing it in students has been elusive to many educators, as students are largely deficient and these skills are difficult to acquire, particularly in underprivileged, minority communities. It is through a social learning environment that Kuhn and colleagues have been able to affect change and promote learning of argumentation.

Social Learning

The curriculum is situated in the sociocultural approach and is based on the premise that the social context is critical to learning (Greeno, 1989; Mason, 1996). Unlike much of the learning that takes place in today’s classrooms, in which a student learns passively, authentic social learning occurs through active undertakings with peers (Rogoff, 1994). Studies on social learning show significant advances for students in many disciplines. Collaboration with peers necessitates overt engagement, which allows students more exposure to multiple models and thus increases not only reasoning skills but also knowledge of specific content (Brown & Palinscar, 1989; Brown & Campione, 1990). While social, collaborative learning is beneficial across various disciplines and topics, it has been found to be especially critical to development of argumentation skills (Kuhn at al., 2013).

Dialogic Argumentation Curriculum

The successful pedagogical method designed by Kuhn is effective largely because of the practice of argument in a rich social context.

> "The rationale for the intervention rests on the close connection between an individual argument as a product and dialogic argumentation as a process... we see dialogic argumentation as a productive vehicle for developing the argumentive competencies of young adolescents both because of this close connection and because of the developmental origins of argumentation in everyday talk... Further, the longitudinal aspect of our approach is based on the view that the development of dialogic argumentation skills and values requires sustained and dense practice in rich environments that require and value them." (Kuhn & Moore, 2014).

The extended intervention described in detail by Kuhn, Hemberger, & Khait (2014) engages students in sustained dialogic argumentation with peers, meeting bi-weekly over the course of two school years. The cycle of activities consists of four topics per school year, polling students to determine their position and divide the class into small same-side groups based on their reported position. For each topic, students are engaged in the same activities in the same order. These include: same-side small group work to collaboratively prepare for debate, followed by six sessions of electronic dialogs between pairs of opposing-side classmates, then a return to small groups to consolidate debate points and strategies in preparation for the showdown, a whole-class debate conducted by individual opposing-side students, debrief of the debate transcript, and finally, individual written essays on the topic. An overview of the workflow of activities completed for each topic in the curriculum is presented in Appendix A.

In particular, the use of electronic collaborative dialogs affords an ideal medium to employ and study expert modeling as a manipulation. Students have been found to imitate one another when participating in collaborative dialog (Anderson et al., 2001; Kim et al., 2007) and the electronic medium used in the dialogic argumentation curriculum may allow for a greater effect. Argumentive dialogs with more capable interlocutors may prompt not only student adoption of advanced strategies, but may promote higher-order thinking and meta-awareness more broadly. The electronic dialogs increase the potential for reflection, as they provide a written record of the dialogic exchange, and are used for reference in later activities. This review of dialog allows students to revisit and integrate previous conversations into new thoughts, increasing engagement and learning (Kuhn, Goh, Iordanou, & Shaenfield, 2008). It follows that electronic dialog with a relatively "expert" arguer may increase adoption of more advanced strategies, as well as reflection and learning.

Development of Argumentation Skills

The curriculum has been generally successful in developing students' argumentation skills. Data show specific cognitive gains and skill acquisition for students who participate, compared to closely matched peers who do not (Kuhn & Crowell, 2011). Students engage in a series of activities, each associated with specific cognitive goals. (See table 1.)

Table 1. Summary of curriculum activities and associated cognitive goals

Curriculum activity	*Cognitive goal*
Generating reasons	Reasons underlie opinions. Different reasons exist for the same opinion.
Elaborating reason	Good reasons support opinions.
Evaluating reasons	Some reasons are better than others.
Developing reasons into an argument	Reasons connect to one another and are building blocks of argument.
Examining and evaluating opponents' reasons	Opponents have reasons too.
Generating counterarguments to others' reasons	Reasons can be countered.
Generating rebuttals to others' counterarguments	Counters to reasons can be rebutted.
Supporting (and weakening) arguments with evidence	Evidence can strengthen claims. It can also weaken claims.
Contemplating mixed evidence	The same evidence can be used to support or weaken different claims. The same claim can be supported or weakened by different pieces of evidence.
Conducting and evaluating two-sided arguments	Opposing positions must be weighed in a framework of alternatives and evidence.
Constructing an individual argument (written or oral)	An individual argument can be constructed from a dialogic argument.

Research with repeated cohorts over several years has shown numerous specific significant positive outcomes for participating students. Engagement with the curriculum produces improvement in dialogic argumentation both immediately, in response to an opponent's utterance (Felton & Kuhn, 2001), and also over time, measured by an increased proportion of advanced strategies (Crowell & Kuhn, 2014). Furthermore, students participating in the curriculum show improvement beyond the dialogic argumentation to a transfer task of argumentive writing (Kuhn & Crowell, 2011). With engagement in the curriculum, participants also show gains in meta-level awareness, advancing metastrategically (Kuhn et al., 2013), and developing in their level of epistemological understanding (Kuhn & Crowell, 2011). The significant cognitive advances made by participants in the argumentation curriculum beg for further study to explore the underlying factors that explain how these gains occur, with particular attention to the mechanisms facilitating argumentation through social learning.

Factors Affecting Social Learning

Constructivist theories emphasize sociocultural learning, examining the various social factors that impact development. As Vygotsky stressed, language is a critical tool in developing higher level mental functioning (Wertsch, 1991). Language has been found to be a factor that mediates thinking and learning, so a major challenge in teaching argumentation to adolescents is situating the abstract concepts in accessible dialog (Collins, Brown, Holum, 1991). This is addressed in the context of the argumentation curriculum, as it employs Kuhn's (1991) "everyday talk", allowing participants to collaborate using familiar language. Social learning is affected when individuals in a learning community hold asymmetrical roles, or varying levels of competency (Rogoff, 1994). Vygotsky's (1978) "zone of proximal development" (ZPD) refers to the reduction in distance between a learner's potential and actual developmental level, which is caused by interaction with a more capable partner. Vygotsky argued that the learner benefits from social engagement with a more proficient partner and, in particular, that collaboration between a teacher and student allows for higher-order mental functioning (Alves, 2014). While there is clear evidence of student benefit from social constructivist classroom approaches to argumentation (Mason, 1996; Kuhn et al., 2013) there has been less exploration of the potential for greater development through dialog and collaboration with a more capable person- a relative “expert”.

Expert Modeling vs. Direct Instruction

The role of an “expert” in a learning environment can be that of a teacher or a facilitator, dependent on whether the expert uses modeling or direct instruction. The traditional model of teaching by instruction does not appear to be the best method for long-term learning in the case of argument and inquiry skills (Dean & Kuhn, 2007). Direct instruction critically fails to expose students to the mental processes experts employ to reason and problem solve (Collins, Brown & Holum, 1991). Expert modeling, on the other hand, provides opportunity not only for teachers to overtly display internal cognitive processes, but also to provide metacognitive prompts and solicit challenge of presented assertions (Nussbaum, 2008; Asterhan & Schwarz, 2007). Research on expert modeling in other fields shows cognitive gains including improved reading comprehension, (Palinscar & Brown, 1984) as well as quality of student writing (Bereiter & Scardamalia, 1987). Many educational researchers conclude that learners can make the greatest gains through expert modeling rather than direct instruction (Pederson & Liu, 2003). Importantly, expert modeling has been found to best help students apply learning on one task to later, related tasks (Greeno, 1997) and even on more complex tasks (Pedersen & Liu, 2003).

Argument Strategy

In the context of argumentation, gains can be observed through analysis of argument strategy. Literature on argumentation outlines ideal goals and models of argumentive dialog (van Eemeren & Grootendorst, 1992, 2004). At the core of argumentation are counterarguments and rebuttals, which serve to support one's own claim and weaken an opponent's. Questions are also fundamental components, as they are used to undermine an opponent's assertion (Walton, Reed, & Macagno, 2008). These components constitute argument strategies, which can be subjected to analysis. Adolescents' standard approach reflects weak argumentive skill, as it typically involves little attention to addressing or weakening opponents' claims; rather, a major focus is strengthening one's own position. Through intensive, sustained engagement in argumentation , students show gains in argument strategy, reflected in the relation between a student's response and an opponent's preceding statement (Felton & Kuhn, 2001) and specifically in the increasing proportion of counterargument and rebuttal over time (Crowell & Kuhn, 2014). These characteristics can be modeled in experts' dialogic argumentation, which is done here to examine its effect.

RESEARCH QUESTIONS

The present study explores effects of engagement in dialogic argumentation with experts, specifically:

Research Question 1: *Does engagement in argumentation with an expert increase students' use of advanced argument strategies in peer dialogs, compared with students who engage in argumentation only with peers?*

Research Question 2: *Does engagement in argumentation with an expert increase students' immediate use of advanced argument strategies in peer dialogs on the same topic, compared with students who engage in argumentation only with peers?*

Research Question 3: *Does argumentation with an expert increase students' use of advanced argument strategies in peer dialogs, relative to argumentation only with peers, to an extent that manifests itself beyond the treatment context itself***?**

RATIONALE

The present study builds on the preceding theoretical and empirical base to further consider the role of an "expert" in teaching argumentation, with the aim of better understanding some of the mechanisms of argument skill development. The sociocultural approach of Kuhn's dialogic curriculum is an ideal environment to study the effects of expert modeling on learning of argumentation. Previous studies based on the curriculum establish common student outcomes and measures to assess impact of student engagement with experts. Specifically, examining dialogs with experts may ultimately serve to inform educational methods, as an analysis will provide clearer understanding of the mechanisms underlying development and better examine the role of teachers in facilitating argumentation as a social activity.

The present research is rooted in constructivist theories, specifically Vygotsky's (1978) "zone of proximal development", and builds on previous findings of immediate positive effects of expert modeling on student argument (Mayweg-Paus, Macagno, & Kuhn, 2015). The present study aims to investigate the longer-term, global effects of expert modeling on individual adolescents' argument strategies, both in dialogs with experts and peers, as well as on later transfer tasks.

The study hypothesizes improvement among students engaged in dialog with experts, as suggested by constructivist theories, including Vygotsky. Such theories posit that social learning is advanced when students engage in interaction with a more capable partner in a supportive environment. The variance in levels of ability challenge the learner and foster development. Vygotsky describes the distance between potentially achievable development and actual developmental level as the "zone of proximal development" (ZPD) and posits that a social learning experience with a more capable partner or teacher will reduce the size of this gap. In line with these constructivist theories, the present study hypothesizes that electronic dialog with a relative expert will advance students' development within the ZPD. Specifically, students in the experimental "expert" dialog condition will show improved argument strategies, compared to students in the peer dialog comparison condition, in subsequent dialog with peers. Furthermore, the study hypothesizes increasing advantage of the experimental group vs. the comparison group over time, with argument strategies improving for students involved in "expert" dialog over the course of the school year, to a greater extent than the improvement of a non-expert comparison group.

The present study will also build on previous research around expert modeling to explore the effects of expert modeling on a related transfer task. Students have been observed to better transfer strategies learned during a modeled task to another similar task, and even to a more complex task (Pedersen & Liu, 2002, 2003). Specifically, skills in electronic dialogic argumentation have been shown to transfer to individuals' face-to-face verbal argumentation (Iordanou, 2013). These claims will be considered in the context of expert modeling of argumentation strategies, and the study will aim to assess whether transfer effects are present among students engaged in dialog with experts. In line with the previous research on expert modeling and transfer, the present study hypothesizes that students in the experimental "expert" dialog modeling condition will show improved argument strategies on transfer tasks when compared to students in the peer dialog comparison condition.

Data analyzed within each topic is valuable in understanding the evolution of change in argument strategy. However, to gain a better sense of the potential longer-term, global effect of dialogic argumentation with an expert vs peer, the present study first examines performance over the course of the entire yearlong curriculum.

CHAPTER 2

METHOD

Participants

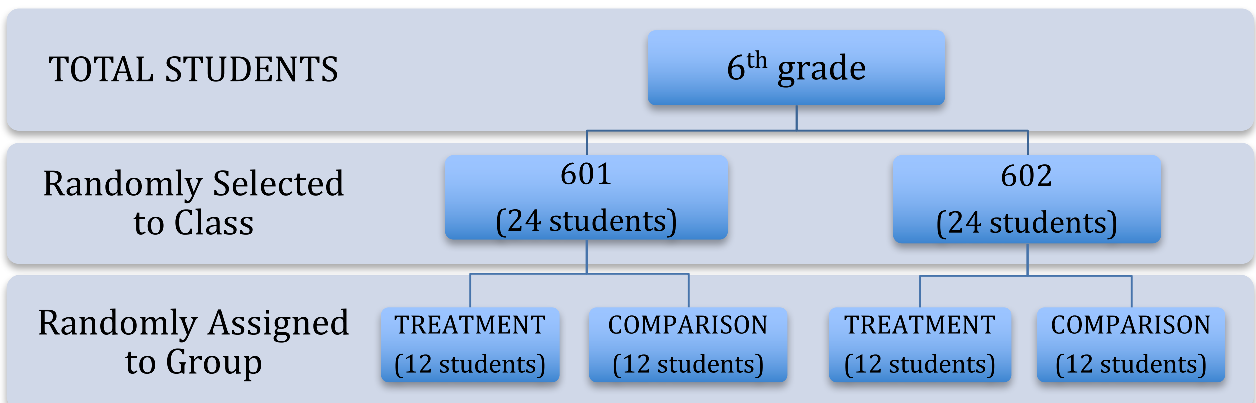
Participants in the study sample are 48 students, spread over two classrooms (601, 602), in the 6^{th} grade at a public middle school in New York City. All students participated in a curriculum in argumentation adopted by the school as part of its regular curriculum. Students were 38% female (18 female students) and 63% male (30 male students). Breakdown per class was as follows: 24 total students in classroom 601 (15 male, 9 female), and 24 students in 602 (15 male, 9 female). The student body is largely socioeconomically disadvantaged, with 92% qualifying for reduced-price lunch. Ethnically, the student body is 82% Hispanic, 14% African-American, and 4% Caucasian. English is a secondary language for many of these students, as 44% are classified as English Language Learners, and several primary languages are spoken by this group of students including Albanian (1%), Arabic (1%), French (1%), Haitian Creole (3%), English (30%) and Spanish (64%).

50 students began participation, but attrition resulted in a final student sample of 48 participants. The 2 losses were due to family moving out of district (1 student), and transfer to a different classroom by school administration (1 student).

Design

The study is designed as a longitudinal, repeated measures intervention with assessment of differences between treatment and comparison groups. Assignment to treatment or comparison group was random. Initially, students were randomly selected by school administration to two classrooms (601, and 602). Experimenters then randomly assigned half of the students in each class to the treatment and comparison conditions. (See figure 1.)

Figure 1. Process of Student Assignment to Treatment/Comparison Groups



All students in the sample engaged in electronic dialogic argumentation in pairs against an opposing-side pair of students for four topics. Students in the treatment condition experienced the manipulation of dialog with an experimenter serving as an "expert" while the comparison group did not. The key dependent variable considered is proportion of advanced type of argument strategy used during electronic dialog with peer pairs. Analysis will be focused on dialogs, with examination of group differences over the course of the entire school year, as well as within each of the four topics debated. Topic 1 serves as a baseline, as treatment was not introduced until Topic 2. Topic 2, 3, and 4 will be used to examine any effects of treatment. Also considered are group differences on a similar transfer task conducted at the end of the school year, examining use of advanced argument strategies in dialog between individual students on an unpracticed, novel topic.

Procedure

Students in the study participated in the dialogic argumentation curriculum designed by Kuhn and colleagues (Crowell & Kuhn, 2014; Kuhn, Zillmer, Crowell, & Zavala, 2013; Kuhn, Hemberger, & Khait, 2014). Students in this study sample had never previously participated in the argumentation curriculum. The class was described as debate, and students met bi-weekly for one class period, as part of their regular sixth grade curriculum. Experimenters in the classroom, identified as coaches, play a largely facilitative role. Over the course of the school year, the class is divided into quarters consisting of approximately 13 class sessions each. For each quarter, a topic scenario is presented for debate, (for a total of four topics over the course of the year) following a structured cycle of activities on each topic to engage students in argumentation.

Topics selected were pilot-tested to ensure a fairly even split in the students' positions. In the 2014-2015 school year, which is the focus of this study, the four debated topics included: (1) homeschool vs. town school, (2) US involvement in the invasion of a poor Asian country vs. no US involvement, (3) trial and sentencing of teens in juvenile vs. adult court, and (4) allowing sale of kidneys vs. only allowing kidney donation. For a detailed topic scenario for each of these four topics, see Appendix B.

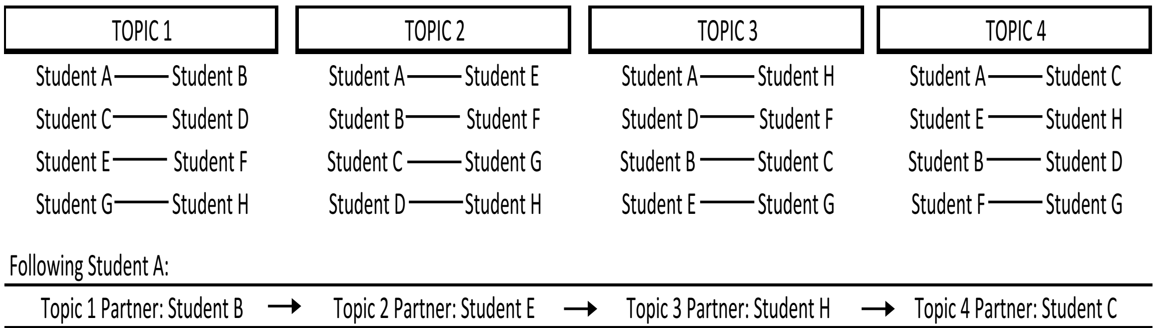
Curriculum Cycle of Activities

For each topic cycle, students indicate their position on the topic and are divided accordingly into same-side small groups. Class sessions then follow a cycle of activities consisting of small-group, pair, individual, and whole-class tasks, outlined in greater detail below. (See Appendix A – Cycle of Activities)

Pregame: (Sessions 1 and 2) The initial sessions for each topic involve students working together in small groups holding the same position on the topic. In their first few small group collaborations, students generate reasons for their position. Students are further asked to solicit three opinions on the topic from people other than classmates. They then incorporate those outside opinions and reasons to their small group discussion with classmates and reflect to evaluate the strength of their stated reasons.

Game: (Sessions 3-8) In the six class sessions following small group work, students are paired with a same-side peer to engage in dialog on the topic against a pair of opposing-side students, arguing with a different opposing-side pair in each class session. Students maintain their same-side partner for the entirety of each topic, but are paired with a new partner for each of the four topics over the course of the year, so they are paired with four partner students in total. (See figure 2.) Though pairings changed with each topic, students were consistently paired with partners within their group (treatment or comparison) so that the same individual students are analyzed as either expert or peer over the course of the entire year.

Figure 2. Sample Student Same-Side Pairs by Topic



Dialogs are conducted electronically (using Google software) and each peer pair is identified by a code, so that student pairs cannot identify the opponent student pair. Students engage with their own same-side partner verbally, before typing to their opponent pair. The electronic medium is particularly useful as it allows for student reflection (Kuhn, Shaenfield, & Crowell, 2011) and during each of these six sessions, student pairs used the transcript of their active online dialogs to complete reflection sheets, aimed at identification and improvement of counters and rebuttals. (See Appendix C - Sample Reflection Sheet.) Electronic dialogs also facilitate data collection, as the electronic record of dialog can be used as a measure for analysis. These game sessions are the primary focus of the present study, as dialogs are analyzed for students' use of argument strategies.

Endgame: (Sessions 9 and 10) Following six sessions of online dialog, students again reconvene in small same-side groups, collaborating to prepare for a final whole-class debate, "the showdown". In their small groups, students review and discuss arguments presented by the opposing side during online dialogs to assess strength and generate or identify best counterarguments and rebuttals to be used during the showdown.

Final: (Sessions 11-13) In the showdown session, students are chosen individually from their small groups to verbally debate an opposing side student, with opportunities for support from the same-side small group. The following session is used for debrief, and coaches provide a transcribed map of the arguments made by each student to lead entire-class discussion about the strategies in each dialog during the showdown. (See Appendix D- Sample Showdown Transcript.) Finally, students write individual position essays on the topic. In the next session, a new topic is introduced and the cycle of activities begins again, repeating for each remaining topic.

Transfer Task

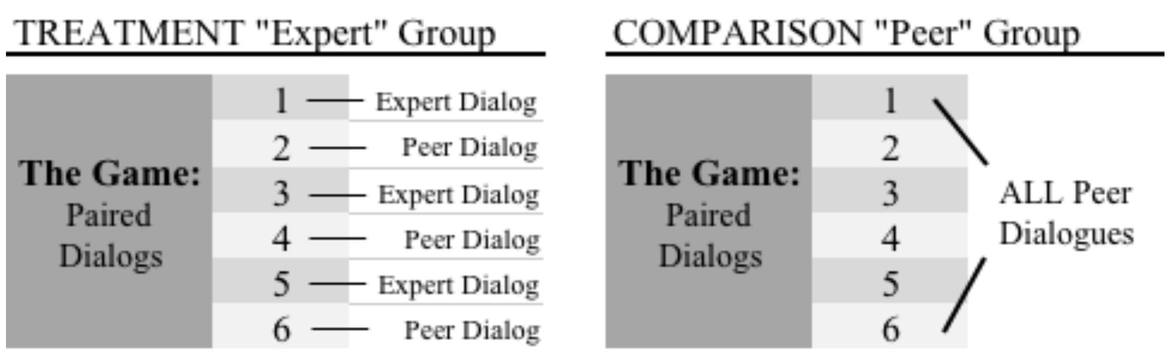
At the end of the school year, following completion of all four topic cycles, students encounter a novel topic, capital punishment. (See appendix E: transfer task scenario.) As for prior topics, students were polled to determine their position on the issue and divided by their side (for or against). For this task, however, students did not engage in small groups or work with a partner, but instead immediately engaged, unpracticed, in written dialog individually against an opposing student. While this task very closely mirrors the dialogic argumentation of the game sessions for each topic cycle, it differs significantly in students' lack of familiarity and engagement with the topic prior to dialog. Further, students engaged individually in dialog with an opposing-side student (as opposed to student pairs) on this task, and only one dialog was conducted on the topic. These differences make these dialogs an ideal measure of transfer.

Experimental Manipulation

The experimental manipulation for the present study involves only the Game portion of the curriculum cycle, consisting of electronic dialogs. All students participated in this portion of curriculum in pairs against opposing peer pairs.

During Topics 2, 3 and 4, the procedure was modified by introducing treatment for students in the treatment group during three of the six electronic dialog sessions. Treatment involved students in the treatment group unknowingly engaging in dialogic argumentation with an "expert" in alternating dialog sessions, (expert dialogs: 1, 3, and 5). During these expert sessions, pairs in the experimental condition engaged in electronic dialog with an experimenter substituting for an opposing student pair. Students in the comparison condition engaged in electronic dialogs only against opposing side peer pairs. (See figure 3.) Experts included the author and several other Ph.D. students.

Figure 3. Experimental Manipulation – Game Session Dialogs



The Google application made it possible for students to interact with opposing peer pairs without identifying their opponents and similarly, students interacted with the expert experimenter without knowing whom they were arguing against, with the assumption that their opponents were another student pair, as was typical.

Experimenters' (acting as experts) role was to facilitate and model advanced argumentation for students, employing high-level argumentation strategies. Experts aimed to model advanced counterargument strategies, specifically ones undermining the opponents' argument or otherwise weakening the opponent's claim. Experts operationalized this goal by using undermining (Counter-U) as often as possible in the course of their dialogs with students, and secondarily using critique (Counter-C). Experts employed counterargument using alternatives (Counter-A) as infrequently as possible in the dialogs. (Counter-A is a weaker form of counter that does not directly address the opponent's argument, as will be defined and illustrated later.) To verify that experts did, in fact, fulfill this goal, analysis is conducted of experts' dialogs.

Analysis

Students' dialogs are examined for increase in advanced counterargumentation strategies, identified as Counter-C and Counter-U. Analysis will be based on student dialogs, specifically dialogs between student pairs, and so will include dialog 2, 4 and 6 for each topic. For the peer group, this is every other dialog, and for the expert group, this is the alternating peer dialogs following dialog with an expert.

While recent work has shown a short-term, immediate enhancement of argument skill reflected in increased use of Counter-U, among students who engage in dialog with an expert, (Mayweg-Paus, Macagno, & Kuhn, 2015) the present analysis is conducted with consideration of a potential floor effect of assessing strategy increase only on the specific subset of Counter U for these academically at-risk, study participants. (NAEP, 2011) For this reason, Counter-C and Counter-U are combined to represent advanced strategy in the statistical analysis. To consider Counter-U specifically, given typical performance of this low-performing population, numbers of student pairs who use a Counter-U at least once is identified for each group. Each counterargument strategy (Counter-A, Counter-C, and Counter-U) is also examined separately.

CHAPTER 3

RESULTS

Dialogs over the entire school year are analyzed first to address research question 1. Because student pairs changed for each topic, for an appropriate year-long comparison, use of advanced strategies were compared for Topic 1 and Topic 4, eliminating pair partners that would be redundant in the data set, leaving six student pairs. Argument strategies were also examined for all twelve dialogs over the course of the school year by plotting mean proportions used by all 24 student pairs at each time point, across topics.

To address research question 2, further analyses are conducted to examine change in strategy use within each topic. Because students never previously participated in the argumentation curriculum, and because treatment was not yet introduced, Topic 1 is analyzed as a baseline assessment of students' argumentation skill level. Topic 2, 3 and 4 are analyzed to examine differences between expert and peer groups in use of advanced strategies and for each strategy type.

Research question 3, regarding transfer effects, is addressed through analysis conducted to assess strategy use on the transfer task of dialog on a novel topic at the end of the school year (after completion of all four topic cycles). The data for this activity are from a single dialog between two individual students, and comparisons are made between expert and peer groups.

Electronic dialogs between opposing student pairs provide the principal measure of participants' argumentation skills. Dialogs are initially segmented into on- or off-topic idea units to identify data for coding. As the present study builds on previous work by Mayweg-Paus, Macagno, & Kuhn (2015), coding is conducted to be consistent with that prior work.

Segmenting Dialogs into Idea Units

Statements made in consecutive turns in argumentive discourse often contain several different ideas. Coding the dialogs thus requires first segmenting the statements made in one turn into idea units, defined as utterances intended to convey a specific single point (Jucks & Paus, 2013; Asterhan & Schwarz, 2009). Segmenting dialog into idea units divides utterances containing multiple points but also combines those conveying a single (often redundantly stated) point. Twelve dialogs generated by participants in the present study but not included in this data analysis were segmented into idea units independently by the author and another coder to establish inter-rater reliability. Agreement of 89% idea units was achieved, differences were resolved by discussion, and the author then segmented all dialogs for the present analysis.

A one-way analysis of variance (ANOVA) was conducted to determine whether there were significant differences in means of idea units across the four topics. The assumption of homogeneity of variance was violated, so the Welch F-ratio is reported. There was a statistically significant difference in mean idea units across the four topics, F (3, 307.886 = 10.749, $p < .001$). Post-hoc comparisons using the Games-Howell test indicated that the mean of idea units for the baseline, pre-treatment Topic 1 ($M = 5.5$, $SD = 1.407$) differed significantly from the mean of idea units for Topic 2 ($M= 6.8$, $SD = 3.337$), Topic 3 ($M= 6.9$, $SD = 2.223$), and Topic 4 ($M = 6.8$, $SD = 1.831$). Post-hoc comparisons using the Games-Howell test indicated no significant differences between topic 2, 3 and 4 (all topics that included the treatment). (see table 1)

Coding of Idea Units

An initial coding of idea units was performed to identify those that were on-task, i.e., related to the topic being discussed. A total of 66 idea units from study participants' dialogs not included in this analysis were classified by the author and another coder as on- or off-task, and achieved agreement of 96%. (kappa = .643, $p < .001$) The author proceeded to classify all idea units for this analysis as on- or off-task.

As determined by a one-way analysis of variance (ANOVA), there were statistically significant differences in means proportions of on-task idea units across the four topics $F(3, 568) = 82.319$, $p < .001$. Much like results on comparing mean idea units, post-hoc comparisons using Tukey's HSD test indicate a significant difference between the mean proportion of on-topic statements in Topic 1 (M = .898 SD = .096) and Topic 2, (M= .932, SD= .097), Topic 3 (M= .910, SD=.117) and Topic 4 (M= .927, SD =.095). Comparisons using Tukey's HSD did not reveal any significant differences between Topic 2, 3, and 4. (See table 2.)

Table 2. Mean Idea Units and Proportion On-Topic Idea Units

	TOPIC 1	**TOPIC2**	**TOPIC 3**	**TOPIC 4**
IDEA UNITS	5.5 (1.407)	6.674 (3.337)	6.889 (2.223)	6.847 (1.831)
ON-TOPIC	.898 (.096)	.932 (.097)	.910 (.117)	.927 (.095)

(Standard Deviations in Parentheses)

On-task idea units were then coded by argumentive strategy type. The coding scheme employed in this study originated in work by Felton and Kuhn (2001) and Crowell and Kuhn (2014) and was further developed by Mayweg-Paus, Macagno, and Kuhn (2015). As the coding scheme centers on goals of dialog, idea units are coded based on their functional role in the dialog (Felton & Kuhn, 2001). Unlike a substantive coding system focused on the content of an argument, this system assigns a code based on the functional relationship of the idea unit to the opponent's immediately preceding statement. The coding scheme includes three main counterargument strategies shown below, in order of increasing strength. (See table 3 for examples.)

> *Counter-A* seeks to weaken an opponent's claim by presenting an alternative claim that is incompatible with the opponent's overall position but does not directly address the opponent's specific claim.
>
> *Counter-C* seeks to weaken an opponent's claim by direct criticism of it, specifically by challenging its conclusion. Within this category, different strategies may be employed to weaken the opponent's claim. The most common one is to identify negative consequences of the argument's conclusion.
>
> *Counter-U* seeks to weaken an opponent's claim by challenging the reasoning underlying it. The arguer may reject an implicit or explicit premise that supports the opponent's conclusion or challenge the link between those premises and the opponent's conclusion (Mayweg-Paus et al., 2015; Walton, Reed & Macagno, 2008).

Table 3. Student Examples of Counterargument A, C, and U

D5	The US shouldn't help the Asian country because we'll lose soldier lifes.	
S6	We have to help since we have better weapons than they have.	CA
H3	If he has homeschool, Nick will not be distracted by other kids that would be at townschool cuz he'll be by himself.	
T7	But being by himself is bad because he won't have other kids to make friends with.	CC
S6	There were only 10,400 kidneys available in 2009. Obviously, we don't have enough donated.	
D5	Yeah, in 2009, but we are talking about 2015. Just because there weren't enough that year doesn't mean there isn't enough now.	CU

The functional coding scheme also includes codes for students' statements that remain on-task but do not aim to weaken the opponent's position (e.g., Unconnected, Clarify; see table 4). On- task idea units from twelve dialogs generated by present study participants but not used for this data analysis were independently coded by the author and another coder to establish inter-rater reliability, achieving 82% agreement (kappa = .711, p < .001). Differences were resolved by discussion. To ensure that coding was blind to treatment or comparison groups, the author removed all indicators of group from the dataset, assigning each dialog a new, numerical student pair ID number, independent of group belonging and then proceeded to code all idea units in the present data set.

Table 4. Functional Coding Scheme

Transactive questions	
Agree-?	A question that asks whether the partner will accept or agree with the speaker's claim
Case-?	A request for the partner to take a position on a particular case or scenario
Clarify-?	A request for the partner to clarify his or her preceding utterance
Justify-?	A request for the partner to support his or her preceding claim with evidence or further argument
Meta-?	A question regarding the dialog itself (vs. its content)
Position-?	A request for the partner to state his or her position on an issue
Question-?	A simple informational question that does not refer back to the partner's preceding utterance
Respond-?	A request for the partner to react to the speaker's utterance
Transactive statements	
Add	An extension or elaboration of the partner's preceding utterance
Advance	An extension or elaboration that advances the partner's preceding argument
Agree	A statement of agreement with the partner's preceding utterance
Aside	A comment that does not extend or elaborate the partner's preceding utterance
Clarify	A clarification of speaker's own argument in response to the partner's preceding utterance
Coopt	An assertion that the partner's immediately preceding utterance serves the speaker's opposing argument
Counter-A	A disagreement with the partner's preceding utterance, accompanied by an alternate argument
Counter-C	A disagreement with the partner's preceding utterance, accompanied by a critique
Disagree	A simple disagreement without further argument or elaboration
Dismiss	An assertion that the partner's immediately preceding utterance is irrelevant to the speaker's position
Interpret	A paraphrase of the partner's preceding utterance with or without further elaboration
Meta	An utterance regarding the dialog itself (vs. its content)
Null	An unintelligible or off-task utterance
Refuse	An explicit refusal to respond to the partner's preceding question
Substantiate	A utterance offered in support of the partner's preceding utterance
Nontransactive statements	
Continue	A continuation or elaboration of the speaker's own last utterance that ignores the partner's immediately preceding utterance
Unconnected	An utterance having no apparent connection to the preceding utterances of either partner or speaker

Analysis of Argument Strategy Usage

The functional coding scheme described above was applied to the discourse of the adults serving as experts, as well as to the student participants, in order to verify that the experts did in fact employ and model advanced strategies.

Expert Dialogs

Analysis of experts' utterances includes proportion of on-task units, proportion of counterargument, and types of individual argument strategies contained in these utterances. As indicated in the previous chapter, adults acting as experts sought to model advanced counterargument to students. Specifically, they did so by using undermining (Counter-U) as often as possible in their dialogs with students, and secondarily by using critique (Counter-C). Experts employed counterargument using alternatives (Counter-A) as infrequently as possible, seeking to model the need to address opponents' preceding statements directly.

Analysis confirms that adults met these goals. They averaged 100% on-topic statements, and employed counterarguments in an average of 97.67% (SD = .009) of their idea units. Of their total on-topic idea units, experts used Counter-U an average of 36.1% (SD = .084), Counter-C an average of 46% (SD = .056) and Counter-A an average of 15.7% (SD = .020). These means are fairly consistent across topics (Topic 2, Topic 3, and Topic 4). (See table 5.)

Table 5. Proportion Use of Argument Strategies by Experts

	Counter-U	Counter-C	Counter-A
Topic 2	.384 (.118)	.427 (.061)	.172 (.034)
Topic 3	.401 (.068)	.472 (.056)	.159 (.088)
Topic 4	.314 (.047)	.494 (.047)	.154 (.100)
OVERALL	.361 (.084)	.460 (.056)	.157 (.020)

(standard deviations in parentheses)

Student Dialogs

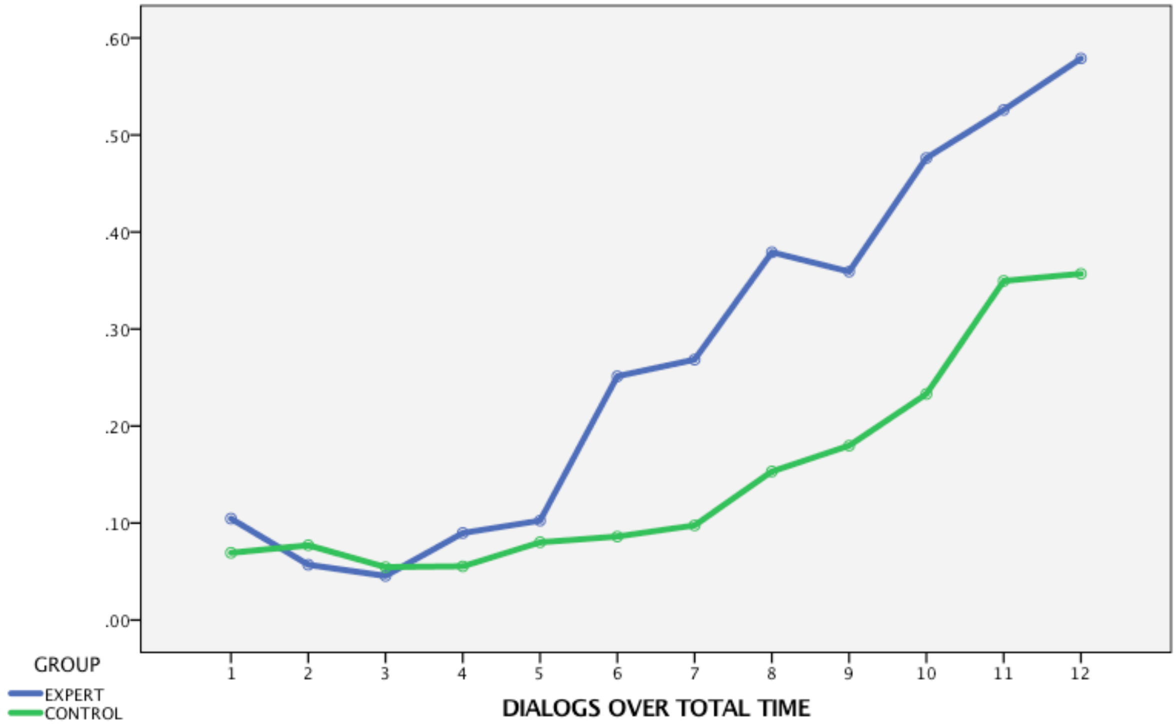
Student dialogs were analyzed to address the research questions identified earlier. This analysis identifies advanced strategies as Counter-C and Counter-U.

Effects Over Total Time

The analysis presented here addresses Research Question 1: *Does engagement in argumentation with an expert increase students' use of advanced argument strategies in peer dialogs, compared with students who engage in argumentation only with peers?*

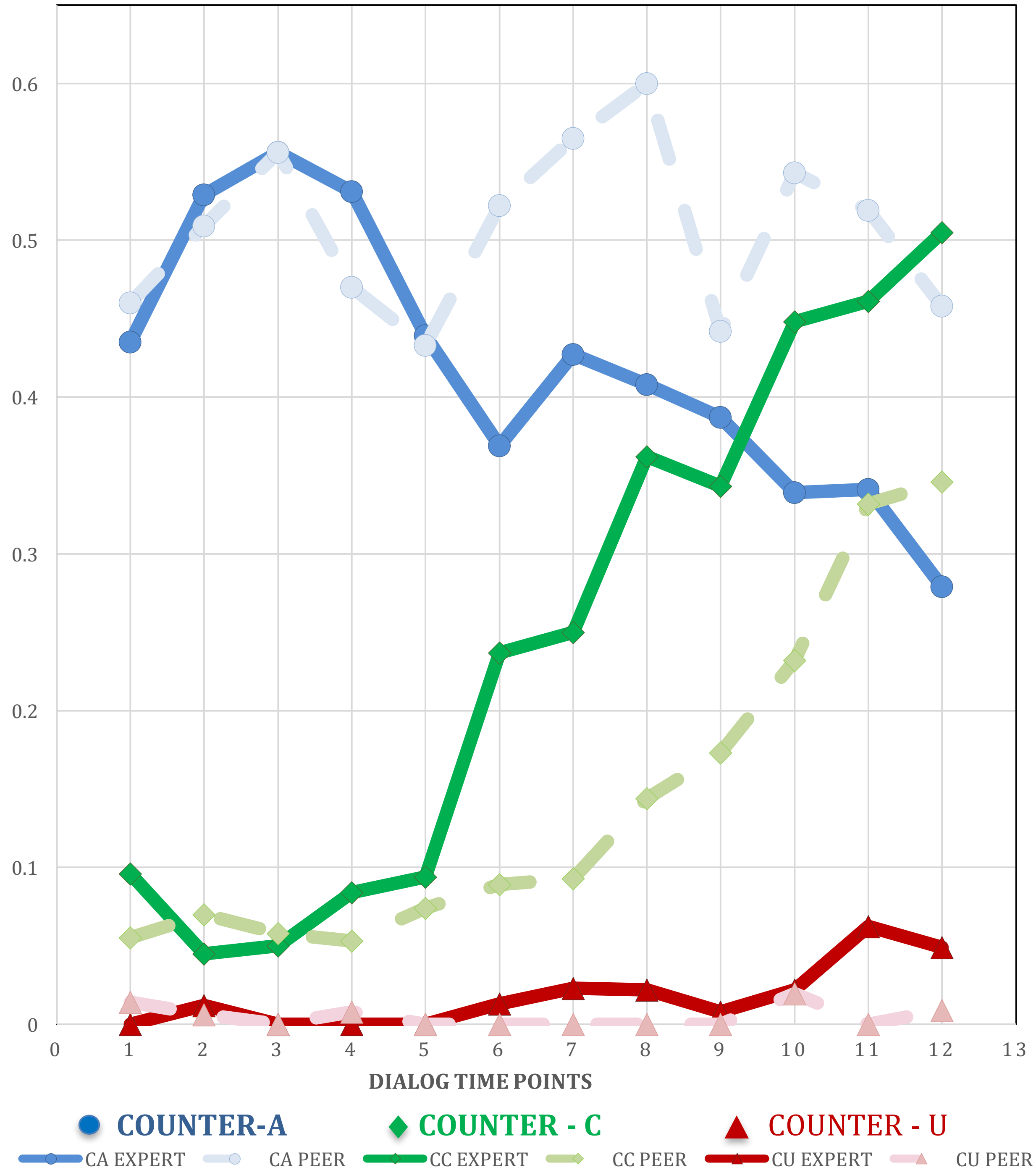
Several analyses were conducted with the aim to examine the overall change in argumentation strategies over the course of the school year. A graphical representation was plotted using marginal means for each individual time point with separate lines for the treatment and comparison groups. (See Figure 4.)

Figure 4. Proportion Use of Advanced Strategies over Total Time



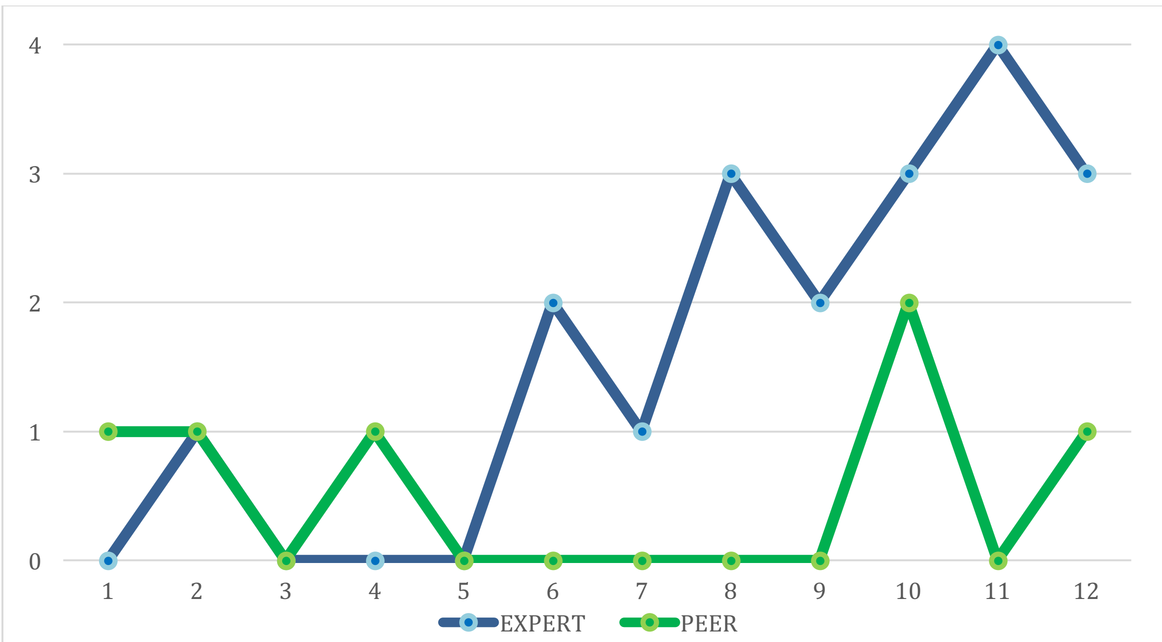
Mean proportions of the 3 specific strategies were also plotted to examine trends over time and by group. Student pairs in the expert group decrease in use of Counter-A over time, while they greatly increase use of Counter-C and modestly use more Counter-U. Students in the peer group also show an increase in Counter-C, although not showing as high proportions as the expert group. Counter-A does not show a strong trend in proportional use for the peer group, but declines over time for the expert group. (See figure 5.)

Figure 5. Proportion Use of Counter A, C, U over Total Time



In addition to analysis of Counter-U by proportional use, this strategy was examined over the study time by number of student pairs employed an underminer, at least once, in a dialog with peers. Much like trends of proportional use, the number of peer pairs using Counter-U increases at the end of Topic 2, and continues in an overall upward trend over the course of the curriculum, for students in the expert condition. Students in the control condition do not show a consistent trend, with very few student pairs ever employing underminers. (See figure 6.)

Figure 6. Number of Students Using Counter-U (at least once) over Total Time by Group



Statistical comparison of all student pairs' dialogs in the expert condition with all student pairs' dialogs in the peer condition is complicated by the fact that student pairings changed for each topic, so a repeated measures statistical analysis across all time points was not possible due to the violation of the necessary assumption of independence. Therefore, to compare Topic 1 and 4, one student from each pair at Topic 1 was selected as the unit of analysis, and any students paired with that student for Topic 1 or 4 were removed from the analysis, leaving an overall 12 participants, 6 in the expert group and 6 in the peer group. Each individual students' data was aggregated over the three time points within each topic to give an overall sum of total on-topic statements for the topic and to calculate proportions of Advanced Counters out of total statements. Assumptions were tested using Mauchly's Test for sphericity, Levene's Test for homogeneity of variance, and Box's Test for equality of covariance matrices, all of which were not significant, indicating that these assumptions were not violated.

Interaction of time by group is significant, $F(1, 10) = 19.799$, $p = .001$ so the effect of being in the expert or peer group differed significantly by time, as expected, according to the hypothesis, as students should not vary significantly in the first, baseline time point, but should vary significantly at the final time point, Topic 4.

The main effect of time is also largely significant, $F(1, 10) = 184.647$, $p < .001$ with all participants significantly increasing proportion of advanced strategies used from baseline to Topic 4. Finally, the main effect of group is significant, $F(1, 10) = 9.207$, $p = .013$ with the expert group using a greater proportion of advanced counterargument strategies on the final topic ($M = .57$, $SD = .109$) as compared to the peer group ($M = .342$, $SD = .076$). (See table 6.)

Table 6. Means for Proportion of Advanced Strategy Use at Topic 1 and Topic 4

	TOPIC 1	**TOPIC 4**
EXPERT	.123 (.052)	.570 (1.09)
PEER	.116 (.069)	.342 (.076)
TOTAL	.119 (.058)	.456 (.149)

Effects Within Topic

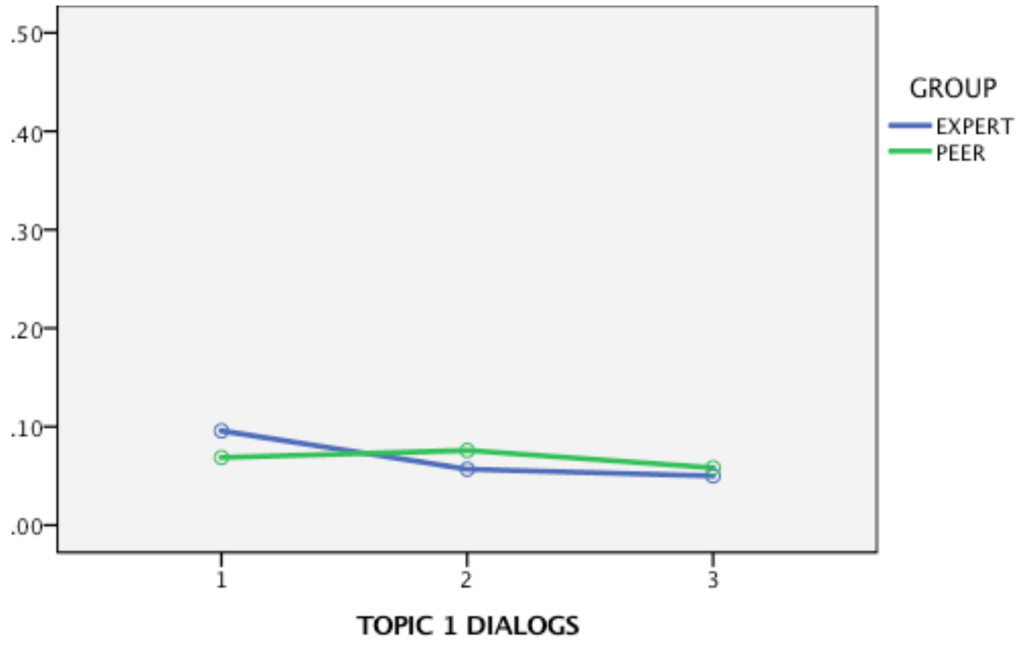
The second analysis addresses Research Question 2: *Does engagement in argumentation with an expert increase students' use of advanced argument strategies in peer dialogs within a topic, compared with students who engage in argumentation only with peers?*

Topic 1

Measures at the three time points during Topic 1 served as a baseline. A mixed factorial analysis of variance (ANOVA) was conducted comparing student pairs' proportion of advanced argument strategies over time. Group (expert or peer) was used as a between subjects factor. Assumptions were tested for all topics using Mauchly's Test for sphericity, Levene's Test for homogeneity of variance, and Box's Test for equality of covariance matrices, all of which were not significant, indicating that these assumptions were not violated.

As anticipated, groups did not differ significantly on the variable of interest. (See figure 7.) The proportion of advanced arguments used in dialogs did not differ significantly by the between-subjects factor group, $F\ (1,22) = .000$, $p = .997$, by the within-subjects factor, time, $F\ (2,44) = .480$, $p = .622$, or by the interaction of group and time $F\ (2, 44) = .351$, $p = .706$. The absence of significant differences for all between- and within-subjects factors confirms equivalent groups by random assignment.

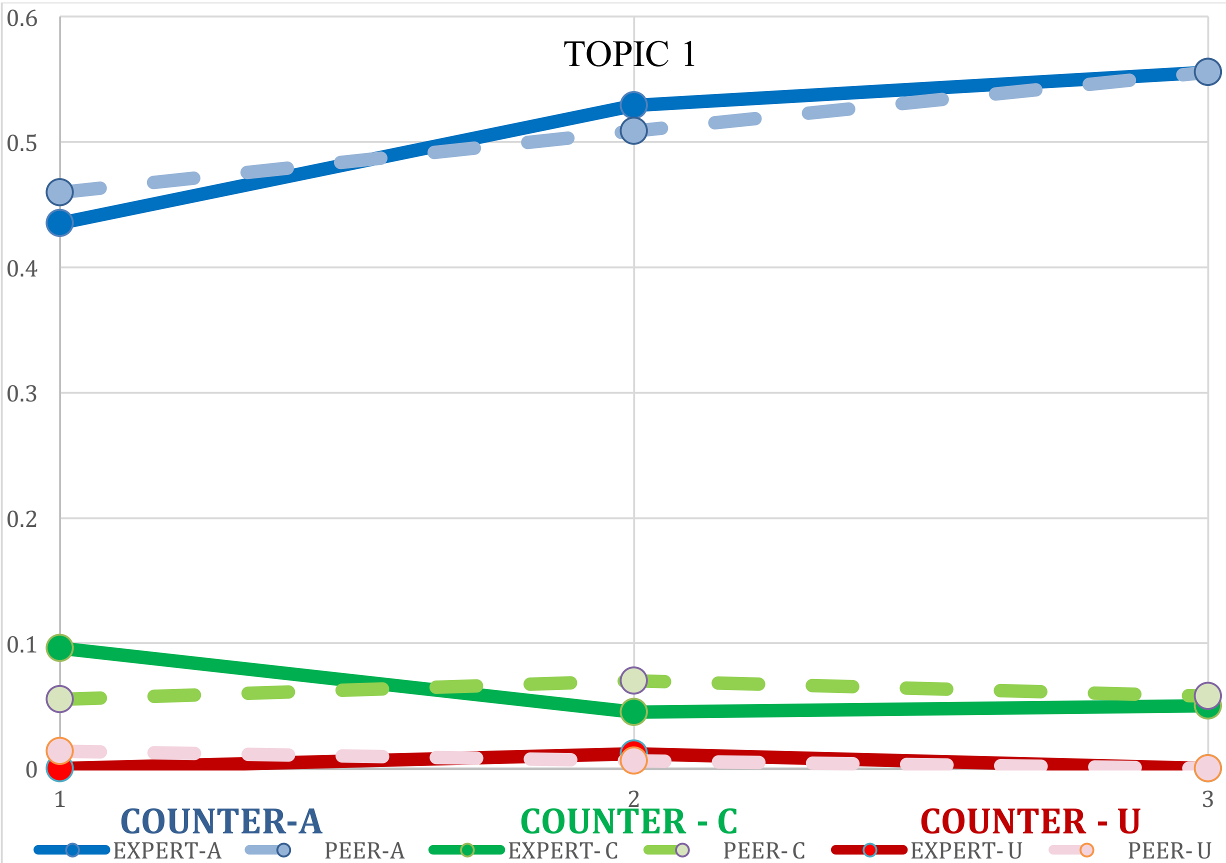
Figure 7. Topic 1- Proportion Use of Advanced Strategies over Time



Mixed factorial analysis of variance was also conducted including class as a second between subjects factor but, as expected because of random assignment of students to classes, proportion of advanced strategies did not differ significantly by class $F(1,20) = 1.275$, $p = .272$. Further, the addition of class as a second between subjects factor did alter results, so class was not used in further analyses.

Analysis by strategy type (Counter-A, Counter-C, and Counter-U) did not reveal any trend over the three Topic 1 time points. (See figure 8.)

Figure 8. Proportion Use of Counter A, C, U across Topic 1 Time Points



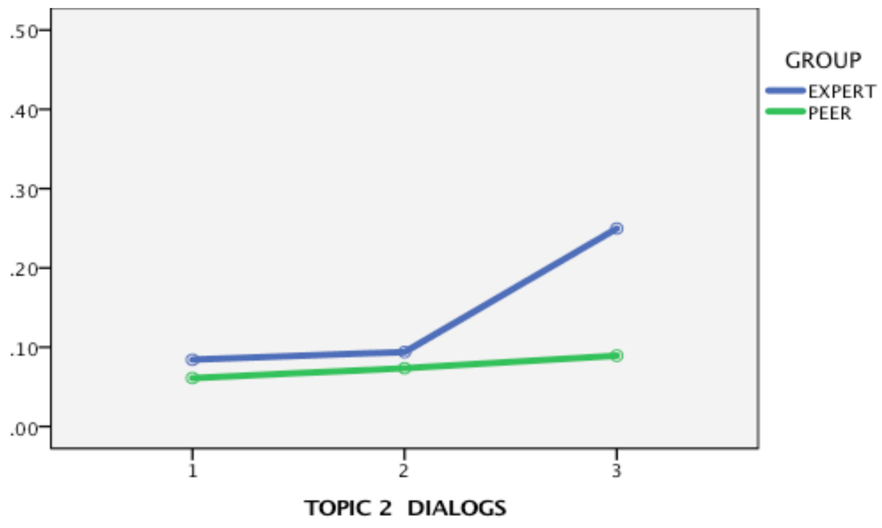
Students rely most heavily on Counter-A (M = 50.94%, SD = .113), using this strategy for approximately half of their on-topic statements on average, and use a far smaller proportion of Counter-C (M = 6.58%, SD = .061). Use of Counter-U was negligible (M= .006, SD = .018), affirming the author's suspicion of potential floor effects in this sample. As for overall counterargument strategies, there were no differences by class or group for any of the individual types of counterargument strategy. (See Appendix F: Topic 1 – Tables and Figures.)

Topic 2

The expert treatment was introduced in Topic 2, as described earlier, for those in the expert group, while those in the comparison group engaged in dialogs only with peers. A mixed factorial ANOVA was conducted comparing student pairs' proportion of advanced argument strategies over time, with treatment group (expert or peer) as a between subjects factor.

There was no significant interaction of treatment group and time, F (2,44) = 2.37, p = .105. However, there was a significant main effect for time, F (2, 44) = 4.157, p = .022. As seen in Figure 9, this trend is almost entirely contributed to by the expert group.

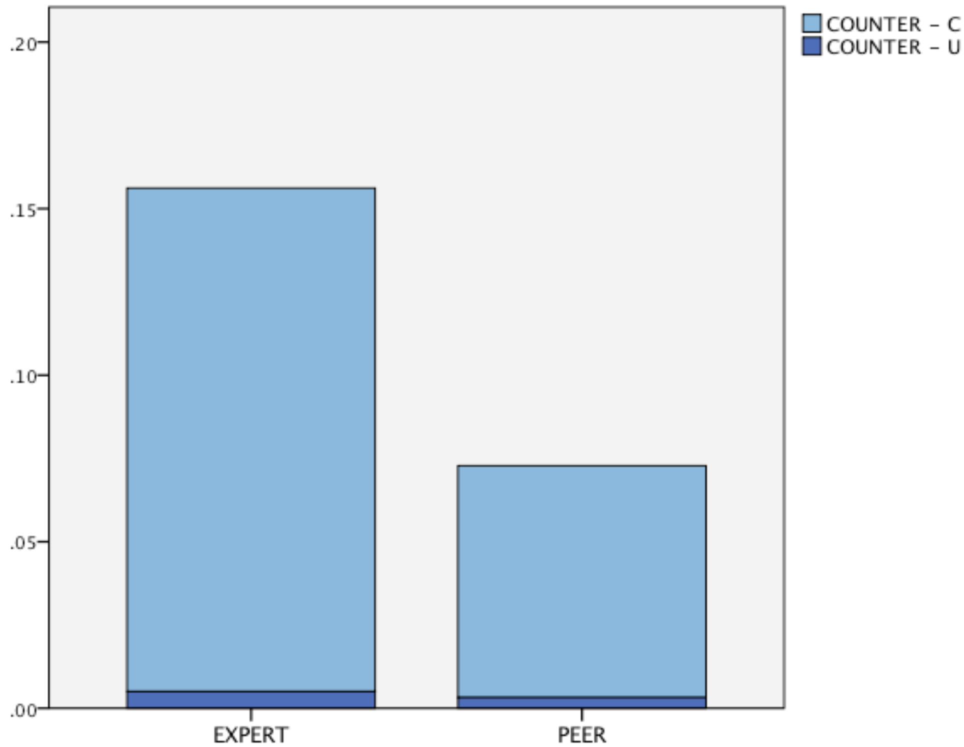
Figure 9. Topic 2- Proportion Use of Advanced Strategies over Time



Pairwise comparisons adjusted by Bonferroni do not show significance for a particular time interval, but tests of within-subjects contrasts show a significant linear trend for time, F (1, 22) = 5.880, p = .024, which supports the descriptive pattern of increase in proportion of advanced strategies over time.

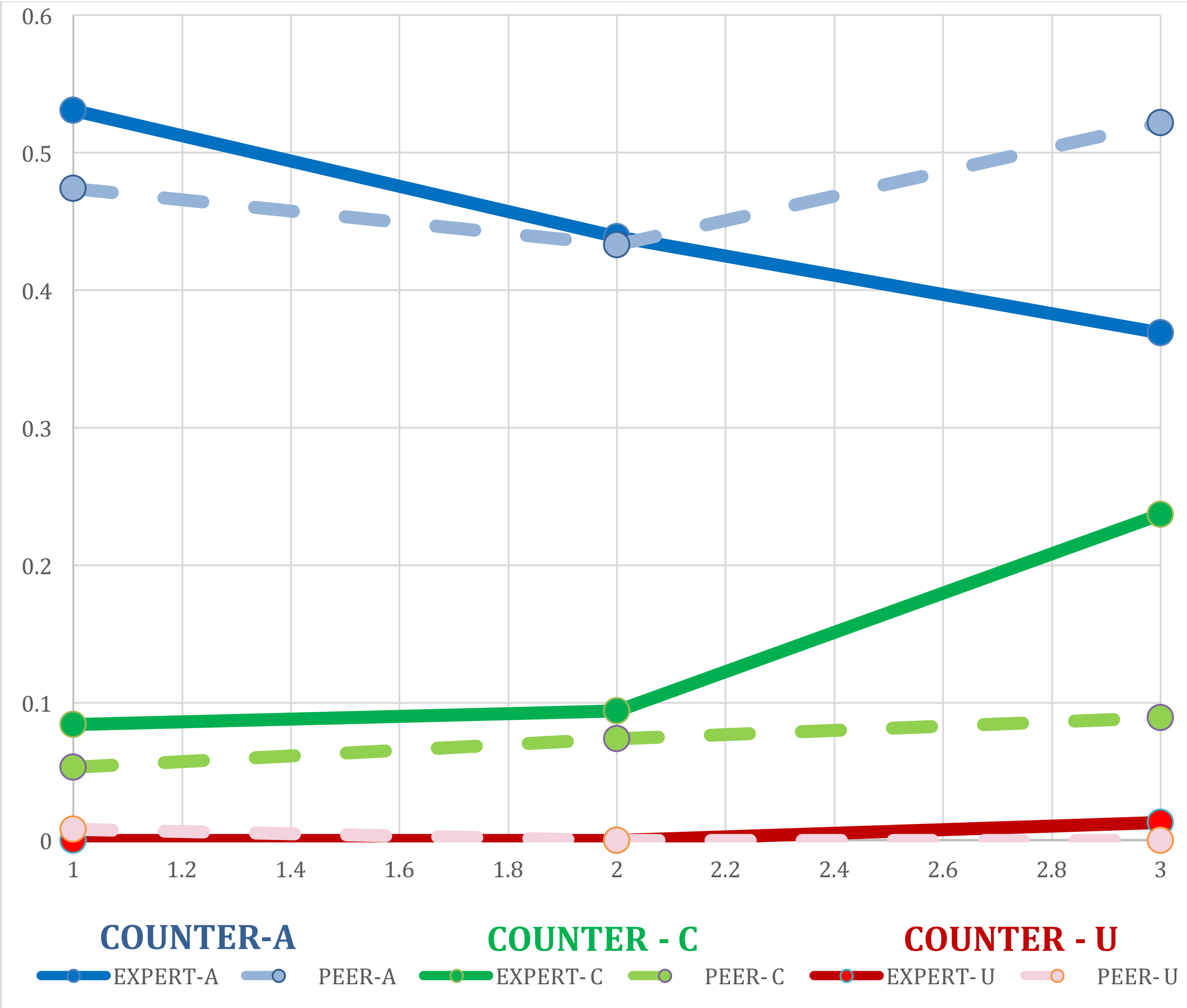
The proportion of advanced argument strategies did not differ significantly by group, F (1, 22) = 4.120, p = .055. Though the difference between groups was not significant, the effect of group is relatively large (η_p^2= .158), consistent with higher mean in proportion of advanced strategies for the expert group, compared to the peer group, overall and across the three time points in Topic 2. (See figure 10.)

Figure 10. Topic 2 - Proportion Use of Advanced Strategies by Group



Analysis by strategy type reveals a decreased reliance on Counter-A for the expert group, with a linear downward trend in mean proportion over time, from 53.1% at time point 1 (SD = .13) to 43.9% at time point 2 (SD = .213) to 36.9% at time point 3 (SD = .144), with no discernible trend of use of Counter-A by the peer group. Proportional use of Counter-C remains low, but appears to increase over time for both groups, and at a greater rate for the expert group. Counter-U remains negligible, with the average proportion used highest in the last dialog at 0.6% (SD = .022). (See figure 11.)

Figure 11. Proportion Use of Counter A, C, U across Topic 2 Time Points



In summary, analysis for Topic 2 finds a significantly increased proportion of advanced argument strategies over time for all students, F (2, 44) = 4.157, p = .022. Though not statistically significant, the expert group has higher mean proportions of advanced argument strategies across all dialogs, as compared to the peer group with a particularly large difference in the final dialog: expert group (M = .249, SD = 1.8) vs peer group (M = .089, SD = .165). (See Appendix G: Topic 2 – Tables and Figures.)

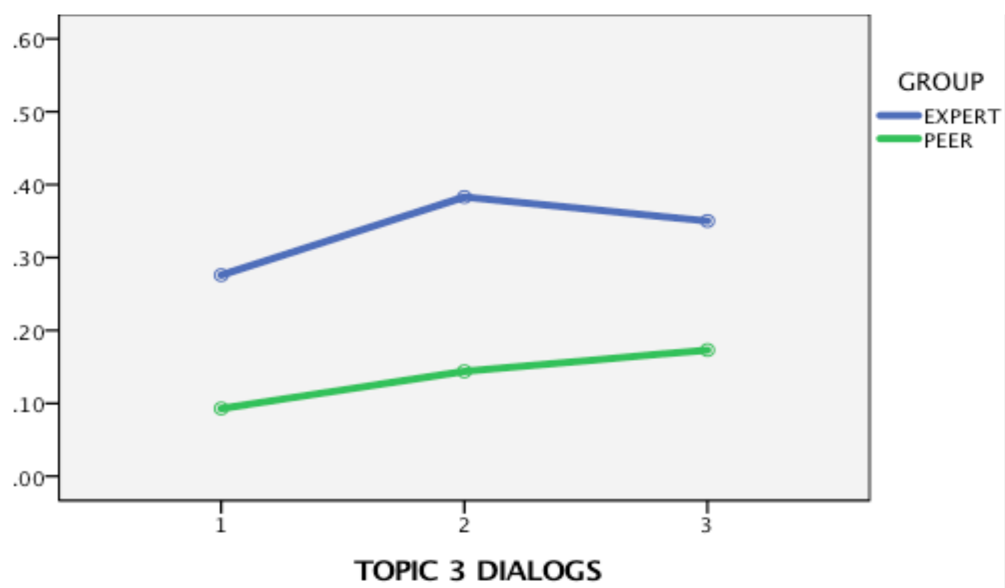
Topic 3

The analysis for Topic 3 follows that of Topic 2. The major difference between Topic 2 and 3 is the re-arranging of student pairs, creating a new set of student pairs for Topic 3. As for previous topics, a mixed factorial ANOVA was conducted comparing proportion of advanced argument strategies over time, with treatment group (expert or peer) as a between-subjects factor.

There was no significant interaction effect of treatment group by time, $F(2,44) = .405$, $p = .669$. Though not statistically significant, $F(2, 44) = 2.806$, $p = .071$, the main effect of time was large ($\eta_p^2 = .113$). Within-subjects contrasts show a significant linear effect for time with both groups increasingly using advanced strategies over time in Topic 3, $F(1, 22) = 5.470$, $p = .029$, $\eta_p^2 = .199$. (See figure 12.)

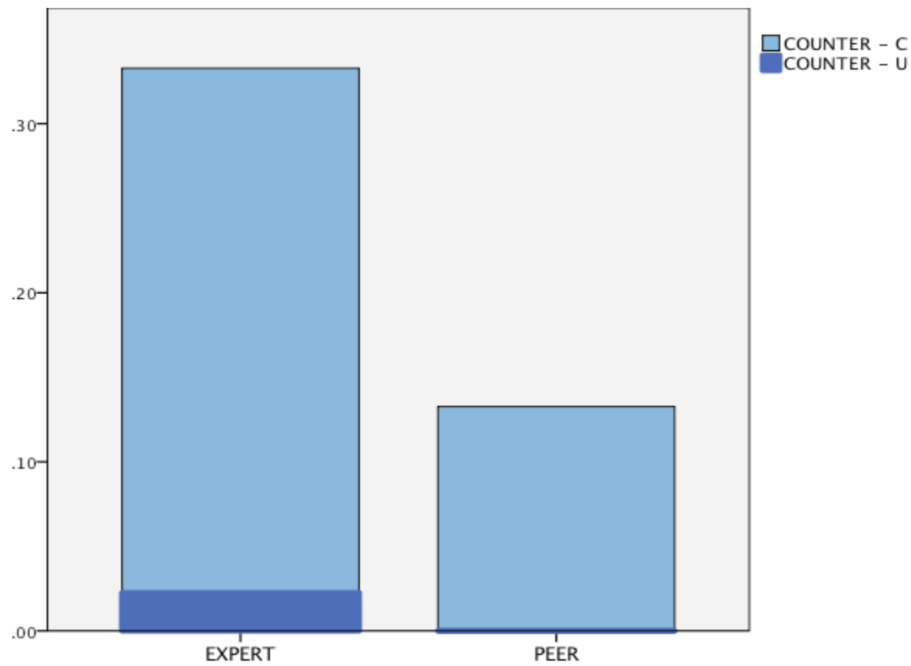
Main effect of group showed a very large effect size ($\eta_p^2 = .467$) and was highly significant, $F(1,22) = 19.265$, $p < .001$, and consistent across dialogs within the topic, as seen in Figure 12.

Figure 12. Topic 3- Proportion of Advanced Strategies over Time



Mean proportions of advanced strategies are higher in the expert group, as compared to the peer group. (See figure 13.)

Figure 13. Topic 3- Proportion Use of Advanced Strategies by Group



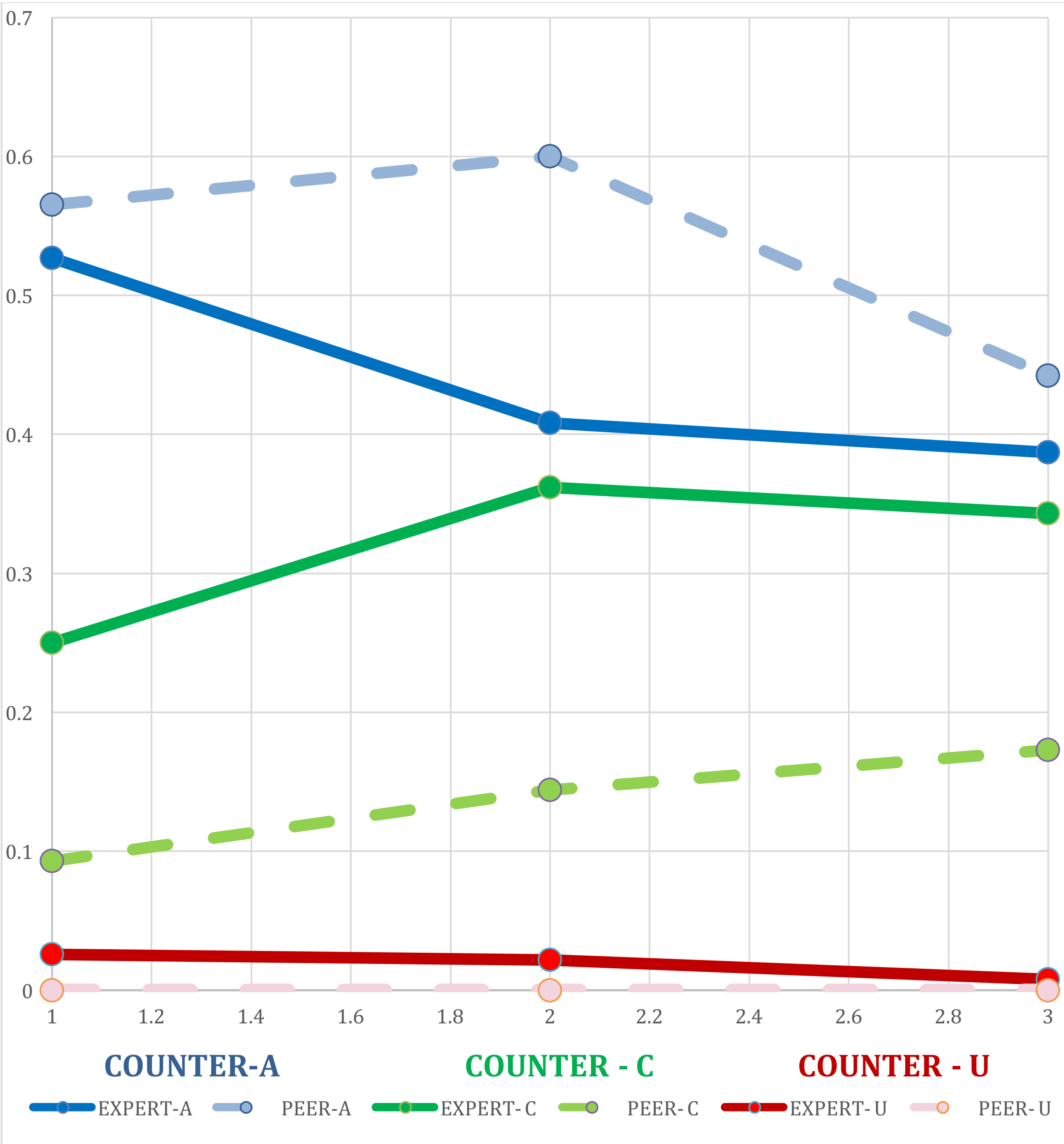
The effects for time and group are supported by descriptive statistics showing a greater proportion of advanced strategies used by the expert group than the peer group for each time point, as well as an increase in mean proportion of advanced strategies used from time point 1 to 2, and from time point 2 to 3, for the peer group. (See Appendix H: Topic 3 Tables and Figures)

Analysis by strategy type reveals numerical trends for group, and over time for both Counter-A and Counter-C, with the change moving in opposite directions for A and C. Counter-A decreases in average proportion from 54.6% (SD = .126) in the first dialog to 50.4% (SD = .210) in the second dialog and finally to 41.4% (SD = .165) at the third dialog. The expert group also shows lower proportion of Counter-A at each time point than the peer group. Analysis of

Counter-C is in contrast to these trends, as it increases in average proportion from 17.1% (SD = .138) at dialog 1, to 25.3% (SD = .19) at dialog 2 and finally to 25.8% for dialog 3, with the expert group showing a higher average proportion of Counter-C than the peer group for each of the three time points. Analysis of Counter-U does not show a discernible pattern over time, but does show difference between groups, as the peer group does not average any detectible proportion of underminers for any of the time periods, while the expert group does continue to average tiny average proportions. (See Figure 14.)

Overall analysis for Topic 3 shows a large, highly significant effect for group, $F(1,22) = 19.265$, $p < .001$, with the treatment group performing better on proportion of advanced strategies and a linear trend of increase in advanced strategies over time $F(1, 22) = 5.470$, $p = .029$. The general trend of improvement in argument by group and over time is supported by the descriptive analysis for individual counterargument types, as the expert group uses a lower average proportions of Counter-A, and higher average proportions of Counter-C and Counter-U than the peer group for each of the 3 dialogs, and participants overall decrease average proportion of Counter-A and increase Counter-C from dialog 1 to dialog 3. Counter-U descriptive analysis was less clear, but again, very low average proportions confirm suspicion of potential floor effects for this group of participants.

Figure 14. Proportion Use of Counter A, C, U across Topic 3 Time Points



Topic 4

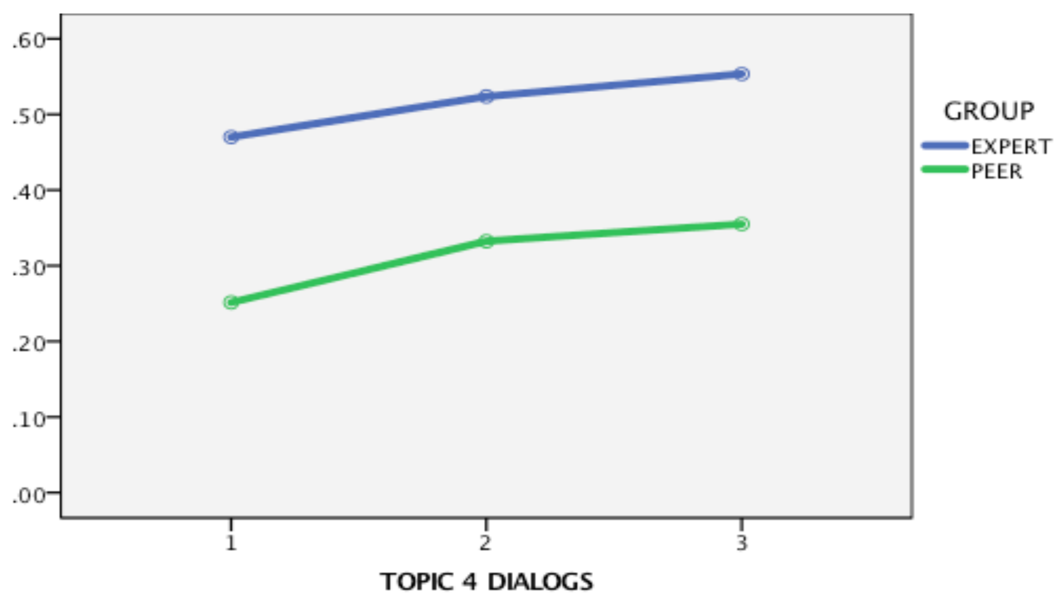
Analysis for Topic 4 follows that of Topic 2 and 3. Like Topic 3, in Topic 4 student pairs are re-arranged to create another new set of student pairs on this final topic of the curriculum.

Students maintain original assignment to treatment or comparison so that analyses by group compare the same individual students over the total study time.

Identical to previous topics, a mixed factorial ANOVA was conducted comparing proportion of advanced argument strategies over time, with treatment group (expert or peer) as a between-subjects factor.

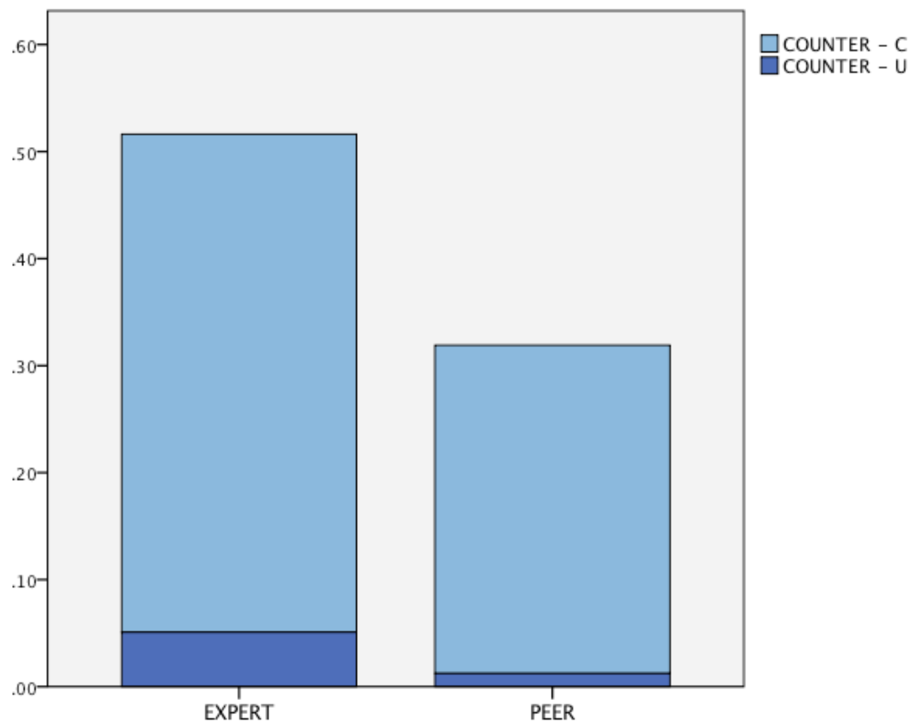
For Topic 4, there was no significant interaction effect of treatment group by time, F (2, 44) = .051, p = .950, so the effect of being in treatment or comparison group did not differ by any particular time interval. Main effect for time was not significant, so overall students' proportion of advanced strategies did not change significantly over the three dialog time points in Topic 4. (See figure 15.)

Figure 15. Topic 4 - Proportion Use of Advanced Strategies over Time



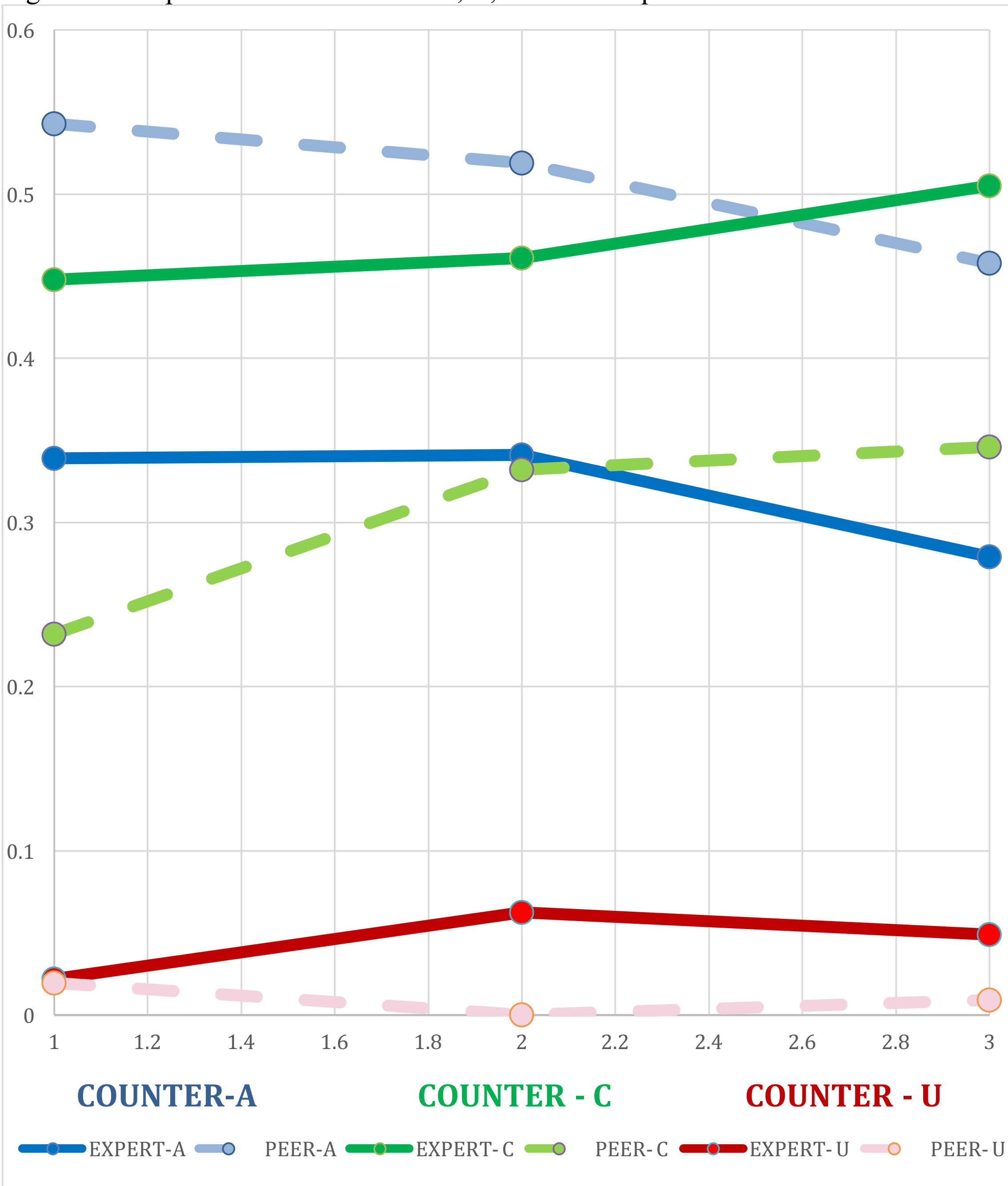
Group (expert vs peer) showed a very large, highly significant main effect F (1, 22) = 28.398, $p < .001$, $\eta_p^2 = .563$. Mean proportions reveal students in the expert group averaged a much higher proportion of advanced counterargument strategies than students in the peer group for each of the three dialogs across Topic 4, and further reveal an increase in proportion of advanced strategies for each of the dialogs for both expert and peer groups. (See figure 16.)

Figure 16. Topic 4 - Proportion Use Advanced Strategies by Group



Analysis by strategy type support the statistical analysis of improved argumentation generally over time, and particularly increase of advanced strategy for the expert group than for the peer group much in the same pattern found in Topic 3. (See figure 17.)

Figure 17. Proportion Use of Counter A, C, U across Topic 4 Time Points



Counter-A decreased in average proportion over time in the expert group, peer group, and for participants overall for each dialog time point from 44.1% (SD = .209) at dialog 1 to 43% (SD = .148) at dialog 2 and finally to 36.9% (SD = .209) at the third and final Topic 4 dialog. The expert group used a lower average proportion of Counter-A than the peer group overall, and for each of the three dialog time points. Analysis of Counter-C had an opposite trend, increasing in proportion over time in the expert group, peer group, and for participants overall from 34% (SD = .192) at dialog 1 to 39.7% (SD = .146) at dialog 2 to 42.5% (SD = .163) at the final dialog. The expert group showed an increase in average proportions of Counter-C than the peer group overall, and for each of the three dialog time points. There was no discernable trend of time for proportion of Counter-U used by overall participants, however, the expert group consistently used a higher average proportion of underminers than the peer group for each dialog time point. (See figure 17 and Appendix I: Topic 4 – Tables and Figures.)

In summary, analysis by topic supports the hypothesis that students engaged in dialogic argumentation with an expert use an increased proportion of advanced argument strategy in paired peer dialogs than students engaged in dialogic argumentation only with peers. Though Topic 2 did not find a significant main effect for group, descriptives and effect size indicated there was a difference between peer and expert groups, and Topics 3 and 4 find increasingly significant effects and large effect sizes for expert vs peer group. (See table 7.) Descriptives on each individual counterargument strategy further support the claim that students in the expert group showed more use of advanced argumentation skills than students in the peer group.

Table 7. Effect Size for Main Effect of Group on Advanced Strategies

TOPIC 1	**TOPIC 2**	**TOPIC 3**	**TOPIC 4**
0.000	0.158	0.467	0.563

(based on partial eta squared)

Transfer Task

Analysis of the transfer task addresses *Research Question 3: Does argumentation with an expert increase students' use of advanced argument strategies in peer dialogs, relative to argumentation only with peers, to an extent that manifests itself beyond the treatment context itself***?**

The same outcome measure of advanced counterargument strategy (proportion of Counter-C and Counter-U out of total on-topic statements) is used for analysis of transfer task performance. As indicated in the previous chapter, unlike dialogs for each of the curriculum topics, dialog on the fifth, novel topic was conducted only once, between individual students rather than in peer pairs. Students in the expert group used an average of 52% advanced strategies in the individual dialog, compared to 35% in the peer group. (See table 8.)

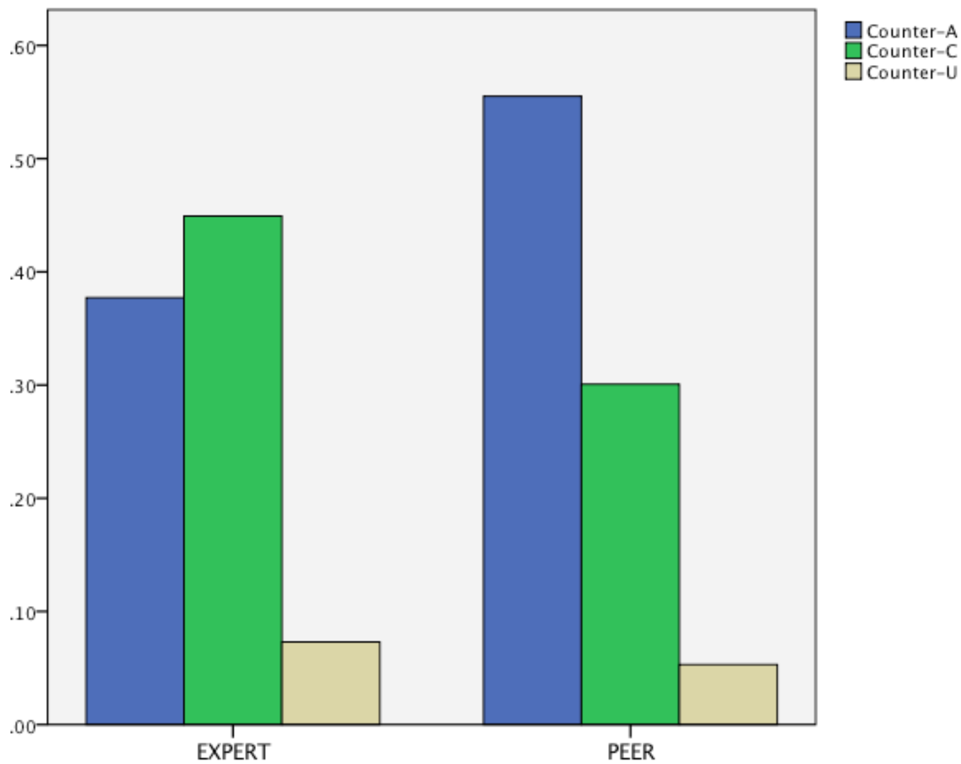
Table 8. Transfer Task - Means for Proportion of Advanced Strategy by Group

	MEAN	**STD DEV**
EXPERT	0.522	.234
PEER	.354	.209
TOTAL	.436	.125

Statistical analysis was conducted using a one-way analysis of variance (ANOVA) as repeated measures are no longer a factor for this task.

As hypothesized, main effect for group was significant, $F(1, 42) = 6.225$, $p = .017$, and students in the expert group ($M = .522$, $SD = .234$) used a significantly greater proportion of advanced strategies on the transfer task than students in the peer group (M = .354, SD = .209). (See figure 18.)

Figure 18. Transfer Task- Proportion Use of Counter A, C, U by Group



A Case Study: Student A

Sample dialogs from Student A (see tables 1-3) exemplify the experience of students engaged in dialogic argumentation, and provide a road map of improved argument through dialog with experts. Three dialogs are outlined, including a peer-peer dialog from baseline, Topic 1, a peer-expert dialog at Topic 2, and finally and individual peer-peer dialog from the transfer task.

Peer dyad-Peer dyad Dialog at Topic 1 (Baseline):

At Topic 1, student A was paired with student B, arguing against student C and D. A sample of their dialog is in table 9. The first topic scenario involves a young boy from Greece (Nick) and asks students to choose a position about whether he should be forced to attend the local town school or be allowed to be homeschooled.

Much like the argumentation shown by their peers in Topic 1 dialogs, Student A (and partner, student B) show functionally weak argumentation skills at baseline. The pair use several nontransactive statements, and few counterarguments in their initial dialog. Furthermore, when counterargument is used, Student A and partner rely exclusively on the weaker Counter-A (alternative), addressing their opponent's previous statement by disagreeing with their position and advancing an alternative argument.

Examination of the dialog by individual moves, shows Students A&B begin the dialog by offering a reason to support their position, that Nick should be homeschooled. When the opposing pair C&D counters *(move 1)*, disagreeing with Student A&B's position and offering an alternative argument for their own position, that Nick should go to town school, Students A&B

respond with one statement *(moves 2 and 3)*, made up of two idea units, which are both nontransactive, as they do not directly address their opponent's previous utterance. Instead, Students A&B return to continue explaining their originally stated point *(move 2)*, and then add a new, unconnected idea that also ignores their opponents' previous point *(move 3)*. Again, C&D counter, disagreeing with Students A&B's previous statement and making an alternate argument *(move 4).* Students A&B respond, in their first transactive statement, addressing C&D's position by disagreeing and offering an alternative in support of their own position *(move 5)*.

Table 9. Topic 1 Dialog between Student A with B and Student C with D

Move	Student A (and B)	Students C & D	Coding
	Nick should stay in home so his parents could teach him more important things		
1		No Nick should go to town school to learn English	Counter-A
2	Nick should stay at home school because he can learn more from his parents /		Continue (Other)
3	and when his parents came from work he could play soccer		Unconnected (Other)
4		But Nick should go to town school so he can play soccer with his friends	Counter- A
5	Nick should stay at home school because he can talk to his friends in the computer		Counter-A
6		Nick should learn new things	Unconnected (Other)
7	Nick's parents are teachers so they can teach Nick /		Counter-A
8	His parents have the right to teach whatever they want		Unconnected (Other)

Peer Dyad with Expert Dialog- Topic 2:

At Topic 2, student A was paired with another student (E), and the treatment of dialogs with experts was introduced. Table 10 is a sample dialog between Students A&E, arguing against an expert, modeling advanced strategies. This particular sample is from the last peer-expert dialog of Topic 2, chosen because it is still early in the treatment, but it is at the time point where some trends of improvement in argumentation are seen in data analysis for students in the expert group. The topic scenario for this dialog involves whether or not the US should get involved in the invasion of a poor Asian country.

In contrast to the dialog from Topic 1, Students A (and partner, student E) show functional improvement in their statements, as almost all are transactive, responding to the statements made by the expert. Furthermore, most of the transactive statements involve counterargument. Though Student A (and partner) still rely mainly on Counter-A, use of Counter-C emerges in this dialog as well.

Students A&E begin the dialog by offering a reason to support their position, that the US should help the poor Asian country. The expert immediately counters with the strongest Counter-U, undermining the student pair by identifying that the conclusion does not follow from the premises *(move 1)* and continues in this line of critique by asking a critical question *(move 2)*. Students A&E counter *(move 3)*, disagreeing with the expert's position and advancing a new idea *(move 3)* but unlike Counter-A seen in Topic 1, Students A&E use justification from the topic scenario to support their claim *(move 4)*. Again, the expert directly addresses the students' claim, attacking their argument by showing that the premises of the students' conclusion *(move 5)*. Students A&E again employ Counter-A *(move 6)*, and again there are subtle differences in its' use, from Counter-A used in Topic 1, as the alternative argument more directly addresses the experts preceding utterance. In *moves 7 and 8*, the expert counters Students A&E's claim directly, critiquing it with justification from the topic scenario. Finally, students A&E directly counter the expert's previous utterance, using Counter-C *(move 9)*, by critiquing the claim's conclusion.

Table 10. Dialog between Student A (paired with Student E) and Expert in Topic 2:

Move	Student A (and E)	Expert	Coding
	The US should help the Asian country because they are poor so they can't fight for themselves		
1		Just because they are poor does not necessarily mean that they can't fight	Counter-U
2		How do you know they can't fight for themselves?	Justify? (Other)
3	In other countries the US had to help like World War 2 because people couldn't to help themselves		Counter-A
4	It says that the US getting in the war is a major reason the killing stopped so if we get in the war in Asia the killing will stop		Continue (Other)
5		That is just one example, so it is not necessarily true that just because the US stopped killing in one place they will be able to stop the killing in another place	Counter-U
6	But we have money so we could make a robot army that could definitely help the Asian country		Counter-A
7		Technology like building a robot army costs a lot of money/	Counter-C
8		and the scenario said that the US concerned about cost	Counter-C
9	Yeah concerned but that doesn't mean they won't spend if its worth it		Counter-C

Peer-Peer Dialog on Transfer Task:

The final transfer task affords an opportunity to separate Student A's contribution to the dialog from any paired peer partner, as Student A argued individually, against opponent F, a student in the comparison condition. Table 11 contains the dialog between Student A and F on the transfer task.

This is the final dialog for Student A, and the topic introduced involves whether a student is for or against capital punishment for serious crimes. Unlike previous dialogs, this topic is one that the student has not practiced prior to engaging in dialog.

Student A begins the dialog by offering a reason to support his/her position, against capital punishment. The opposing student, F, replies with a counter disagreeing with student A and providing an alternative argument to the opposing position *(move 1)*. Student A rebuts F's argument, by attacking its' conclusion *(move 2)* and F, in turn attacks the conclusion of Student A's argument *(move 3)*. In *moves 4 and 5*, Student A again uses Counter-C, critiquing the conclusion of F's statement, and then introduces a new argument building on his/her own previous idea unit, to move the conversation forward. Student F attempts to address the new point made by Student A, *(move 6)* but Student A directly attacks the premise, undermining his/her opponent's statement *(move 7).* When Student F again raises an alternative argument *(move 8)*, Student A critiques the conclusion using the topic scenario as evidence *(move 9)*. Student F again tries to convey the same point made in move 8 through clarifying *(move 10)*, but is undermined by Student A *(move 11)*, showing that the conclusion does not follow from the premise stated by Student F.

Table 11. Dialog between Student A and Student F on Individual Transfer Task

Move	Student A	Student F	Coding
	I don't think someone should be killed if they do a serious crime because if we kill it's the same as they did		
1		Yea but they should be killed because if theyre dead then the criminal wont be able to do any more crimes	Counter-A
2	But that doesn't mean kill them because you can keep them in jail to not do more crimes		Counter-C
3		But if you keep them in jail they can do more crimes in jail so they should be killed	Counter-C
4	But they might not make more crime in jail and /		Counter-C
5	If they are dead then they can't have a chance to be a better person		Counter-A
6		They wont get better since theyre already a criminal	Counter-A
7	Being a criminal doesn't mean you cant get better		Counter-U
8		they cant get better becayse theyre a murderer	Counter-A
9	It doesn't say theyre a murderer- just they did a serious crime		Counter-C
10		Yeah if you do serious crime you do murder	Clarify (Other)
11	Just because someone does serious crime doesn't mean they are a murderer		Counter-U

Examining Student A over time provides insight beyond patterns of proportional use of particular strategies, as it allows for some qualitative exploration. The combination of nontransactive statements and countering only with alternatives at Topic 1 suggests that Student A (along with partner B) has a limited understanding of the nature of argumentation, and the functional role of dialogue to connect one person's point to another person's point. Even when countering, Student A (and B) largely address their opponent's overall position, rather than the specific point made in support of that position. Though this does still constitute Counter-A, it appears to be a particularly weak form, not because of the content but because of its function, which is transactive but still does not directly disagree with the opponent's claim, instead offering counterargument to the opposing position.

At Topic 2, dialog with an expert shows changes in Student A's argumentation (with partner E). Most obvious are trends of students adopting strategies modeled by experts. The dialogue also, however, provides a clear example of the way that experts can use prompts that encourage students to consider strategy metacognitively. In Students A&E's sample dialog the expert asks for justification of their claim. In the next two idea units, the students reference details from the scenario to provide justification. Further, in this dialog with the expert, aside from the obvious advances by proportional use of strategies, and students' almost exclusively transactive statements, subtler changes within Counter-A are illustrated. In both cases where Counter-A is used by Students A&E, there are elements that make it stronger than in Topic 1, including use of evidence from the scenario, and more directly addressing the opponent's specific claim, rather than the opponent's overall position.

The transfer topic dialog clearly illustrates differences in strategies used by the end of the curriculum between expert condition students like Student A, and peer condition students like Student F. Aside from the increase in advanced strategies Counter-C and U, in similar patterns to those suggested by analysis of all student dialogs in the study, important differences between the expert Student A and peer Student F involve use of justification from information provided in the topic scenario, and modeling of expert language. The framework of "Just because (X) doesn't mean (Y)" was used by the expert in dialog with Student A, and that same language appears in the transfer dialog. It is critical to note, however, that Student A does not merely mimic the language modeled by the expert, as examination of the content of the utterance shows understanding of the logic being challenged through that language. Overall, the case study for Student A follows the same general pattern found by data from dialogs in the curriculum, but also provides further insight about some of the subtleties in students' development of argumentation skills.

CHAPTER 4

DISCUSSION

Educational standards emphasize and explicitly require argumentation skills as goals for students' academic progress (CCSS, 2012). The study presented here examines development of argumentation skills, expanding on prior research (Macagno, Mayweg-Paus & Kuhn 2015; Crowell & Kuhn, 2014) to explore effects of engagement in dialogic argumentation with a more capable expert on students' argumentation strategies.

Study participants are middle school students from a disadvantaged background, participating in a twice-weekly argumentation curriculum over the course of a school year, involving repeated sessions of electronic dialogs conducted between peer pairs. Students were randomly assigned to treatment and comparison groups with students in the treatment condition engaged in dialogs sessions with alternating opponents of peer pairs and, unknowingly, with an adult expert and students in the comparison condition only engaged in dialog with paired peer opponents. Analysis of students' dialogs centered around argument strategies, identifying advanced strategies as the more sophisticated counterarguments critique (Counter C) and undermine (Counter U).

Summary of Results

Students' use of advanced strategies in dialogs was examined over the total study time, within each individual topic, and on a related transfer task after completion of the curriculum. Results overall show advances for students engaged in dialogic argumentation with experts.

Effects over Total Time

To assess effects on development of argumentation skills over the entire curriculum, student pairs' dialogs were analyzed to examine differences in argument strategies over time, between the beginning (topic 1) of the curriculum and the end (topic 4), as well as by group, between treatment (expert) and comparison (peer) conditions.

Examination of change in students' argumentation over time revealed trends for the different strategy types. Prior to treatment, students overall rely largely on Counter-A, use a low proportion of Counter-C, and use Counter-U negligibly. Over the total study time, students who engaged with experts improved in argumentation across peer dialogs, showing a pattern of strategies including less use of the weaker Counter-A, and increase of the more advanced Counter-C and U, using greater proportions of Counter-C than Counter-A consistently for the last three dialogs of the curriculum. The peer group also showed improvement over time, though trends for this group were not as strong as for the expert group students. Students in the peer condition increasingly used larger proportions of Counter-C over time in the curriculum, though overall patterns of argument strategy did not match the expert group, as Counter-A remained the dominant strategy across all dialogs. Students' change in argumentation from the beginning to the end of the curriculum were further supported by the statistically significant difference in use of advanced argument strategies at Topic 1 and Topic 4.

Differences between the treatment and comparison groups begin with the introduction of treatment at Topic 2, and persist over the total study time, increasing in size. Students in the expert condition show greater argumentation than students in the peer condition, as expert group students use a smaller proportion of Counter-A, and larger proportion of Counter-C than peer group students across each dialog time point. Proportional use of Counter-U is very low for both groups, but even for this underutilized strategy type, expert students show higher proportional use at most dialogs after treatment begins. Further examination of change in use of Counter-U centered around the number of student pairs who used the strategy at least once in dialog. Consistent with patterns of proportional use, numbers of student pairs using Counter-U in the expert condition increased overall beginning in Topic 2, while student pairs in the peer condition do not show a consistent trend over the total study time.   Findings of greater improvement in argumentation for students in the expert condition are confirmed by the statistically significant difference between the treatment and control groups in an analysis of variance of advanced argument strategies used between Topic 1 and Topic 4.

Overall, findings of change in students' argumentation over the entirety of the school year curriculum show improvement across topics, with effects for students who engaged in dialog with experts beginning immediately at Topic 2, when treatment is first introduced, and increasing with successive peer dialogs, particularly in comparison to students who engaged in dialog only with peers.

Effects Within Topic

Analysis of peer dialogs within the four topics during the curriculum was conducted to explore effects in the immediate, modeled task on students in the treatment and comparison groups. Three student dialogs for each topic are examined for advanced strategy use, as well as for patterns in use of the different argument strategy types by peer pairs.

Topic 1 involved dialogs between only student pairs, as this time period was pre-treatment. Analysis of Topic 1 does not show any trends or significant differences for expert and peer groups or for time, confirming this initial topic as a baseline for all participants in the present study. Similarly, analysis of argument strategy types did not show any major trends over time, with the exception of a very slight increase in proportional use of Counter-A for both expert and peer group students, which may be evidence of a practice effect as students who have never previously participated in the dialogic curriculum gain initial experience with argument.

Topic 2 introduced dialog with experts for participants in the treatment group. Initial dialogs in this topic do not indicate a strong difference between expert and peer group participants, but by the final dialog of Topic 2, students in the expert condition show an increase in advanced strategies, as compared to the comparison condition. Counter A decreases in proportional use overall in Topic 2, and Counter C increases in proportional use largely on the third dialog. This delay in effect on advanced strategies indicates that students' initial engagement with experts does not have an immediate effect, but does have an impact within the topic, as expert modeling dialogs occur twice trends appear in students' strategies on peer dialogs. Statistical analysis supports this pattern, finding only marginal significance but a large effect size for group.

Topic 3 analysis indicates advanced strategies generally increasing in proportional use over the three dialog time points, supported by a significant linear effect of time. Proportional use of Counter A decreases for both groups, with a stronger trend and lower proportions at each time point for the expert group, and Counter C follows the same pattern, but in the opposite direction, increasing for both groups, with a stronger trend and higher proportions at each time point for the expert group. This increasing effect of treatment on students' argument strategies is supported by a highly significant main effect for group.

Topic 4 shows the clearest trends by group and by type of argument strategy. Counter-A decreases over the three dialogs for both groups, with a lower proportion used by expert group students than peer group. Counter-C is used in greater proportion than Counter-A for the expert group, and continues to show and upward trend. Expert group students use advanced strategies Counter-C and Counter-U in greater proportion over Topic 4 than peer group students. These trends are supported by a very large, highly significant main effect for group.

Transfer Task

Effects persist beyond the immediate context of paired dialogues on a practiced topic to individual dialog on a novel topic. Proportional use by strategy type shows similar patterns to those found in Topic 4, with students in the expert condition using significantly greater proportions of Counter-C than Counter-A on the transfer task. In comparison to the peer group, expert students used lower proportions of Counter-A, and significantly greater proportions of advanced strategies Counter-C, and Counter-U.

Implications

Theoretical Implications

Results of the present research support use of a dialogic approach to develop argumentation skills in students, and find more advanced development through the process of repeated social interaction with a more capable partner. Vygotsky (1978) describes the process by which students learn from others in a social, collaborative environment to make gains beyond the actual level, based in traditional measures of individual performance, to the proximal level, based on the students' performance in collaboration with a more competent other, arguing that learning should be based in a collaborative context beyond the student's immediately demonstrated capacities.

Vygotsky proposes that learning "creates the zone of proximal development; that is, learning awakens a variety of developmental processes that are able to operate only when the child is interacting with people in his environment and collaborating with peers" (1978) and thus that the role of the teacher or expert is "only useful when it moves ahead of development (because) then it impels or wakens a whole series of functions that are in a stage of maturation lying in the zone of proximal development" (Vygotsky, 1978).

Unlike the traditional classroom approach of direct instruction, in the context of the argumentation curriculum, the role of the teacher or expert is to facilitate students' development through deep, repeated, collaborative engagement with argumentation and, in the present study, to engage students with advanced, sophisticated counterargument strategies. Effects of the intervention follow the theoretical pattern of proximal development, with advanced argumentation skills developing for students engaging with experts in the collaborative, social context of the curriculum modeling strategies beyond the students' demonstrated individual capacities. Students in the expert condition show proximal development, improving by each type of strategy in greater proportion than students in the peer condition. This effect persists over the entire school year, as students engaged only with peers continue to rely primarily on the weaker Counter-A in dialogs and students engaged in dialogs with experts use increasing proportions of the more advanced strategy Counter-C, over time, reaching a point of using Counter-C consistently more than Counter-A in argumentive dialogs.

In the present intervention, social and cognitive development are not explicitly distinct entities; rather, the dialogic argumentation curriculum creates a culture of intellectual engagement, and students adopt the processes externally modeled by experts. This is evidenced by the fact that the change towards favoring stronger, more direct counterargument critiquing opposing propositions occurs outside of dialogs with experts, in subsequent dialogs between opposing peer dyads. Students' use of increasingly advanced strategies in their peer dialogs indicates an understanding, mastery, and valuing of the strategic function, rather than simple, immediate mimicking of the experts' model.

Educational Implications

Participation in the dialogic argumentation curriculum has shown gains for students that extend to students' writing (Kuhn & Crowell, 2011; Kuhn, Zillmer, Crowell, & Zavala, 2013), dialog (Crowell & Kuhn, 2014) , use of evidence (Kuhn & Moore, 2015) and metacognitive processes (Kuhn, Goh, Iordanou, & Shaenfield, 2008). The present study originated in prior research on interaction with an expert in the context of the argumentation curriculum, showing immediate improvement in counterargumentation, with greater use of undermining (Counter-U) for students in the expert condition (Mayweg-Paus, Macagno, & Kuhn, 2015). Here we explore maintenance and transfer of such gains.

Findings of significant change in advanced strategies from Topic 1 to Topic 4 indicate improvement over time for present study participants, in line with previous findings that the curriculum generally supports improvement in argument strategy use over time (Crowell & Kuhn, 2014). Group effects indicating increase in proportional use of advanced strategies at each treatment topic support prior research showing immediate advances for expert condition participants (Mayweg-Paus, Macagno, & Kuhn, 2015). Expanding on those findings, the present study finds significant group effects in proportional use of advanced strategies from Topic 1 to Topic 4 indicating a more global effect of dialogic engagement with an expert, further supported by the increase of effect sizes for group with each subsequent topic after baseline over the total study time.

This trend of increase with time overall is important, because it shows that students are not improving in the same way, merely copying modeled strategies for each topic. Rather, students are developing argumentation skills from one topic to the next over all dialogs, suggesting mastery and valuing of argument strategies. Overall long-term advances for students in the expert condition are further supported by evidence of transfer effects, with significantly more advanced strategies used by expert group students in a single, written dialog between individual students on a novel, unpracticed topic.

Implications for Developing Argument Skills and Values in Educationally Disadvantaged Populations

The present study was conducted with a sample of participants from a population of students from a socioeconomically and educationally disadvantaged background. Traditionally, these "at risk" students are not engaged in curriculum aimed at developing higher-order cognitive skills. While findings generally show poor argumentation ability in middle school students this is particularly true for minority students from low-income neighborhoods, like the sample in the present study (NAEP, 2011), and these educational disparities may account for some of the differences in patterns of argumentation used by students in this research, as compared to prior work by Mayweg-Paus, Macagno, & Kuhn (2015).

Inconsistent with prior work on expert modeling in argumentation (Mayweg-Paus, Macagno, & Kuhn, 2015), significant improvement for expert students in the present study was not immediate and was not limited to Counter-U. Counter U, in fact, was rarely used by any students in the present study, reaching a maximum use by 5 (of 24) student pairs in any dialog, and with the highest mean proportion used reaching 6.2% (SD = .029) for the expert group and 2% (SD = .047) for the peer group in Topic 4. Despite low use, the trajectory of Counter-U over repeated engagement with experts suggests potential for further improvement with continued expert engagement, both in the direction of more students using the strategy and with more proportional use in each dialog over time. These findings confirm suspicions of a floor effect for the present student sample, based on a low level of argumentive skill at baseline. Evidence of improvement in the expert condition, however, is in line with Vygotsky's zone of proximal development, as modeling of strategies beyond the students' demonstrated capacity creates the collaborative learning context for proximal development. By the end of the year-long curriculum, students who engaged with experts are able to employ advanced strategies significantly beyond their baseline "actual" development.

Examining expert group change across all peer dialogs as time points over the total study time shows that the trend for improvement in advanced counters does not immediately follow students' first engagement with an expert, but begins at the end of Topic 2, with substantial improvement for Counter-C at the third dialog, and substantial improvement in Counter-U not occurring until the end of Topic 3. While this development in argument strategy is delayed, improvements are still seen over the total study time. Underminer use analyzed by number of student pairs follows patterns of proportional use, showing an increase at the end of Topic 2, continuing to the end of the curriculum. Overall, students in the expert condition show downward trends in proportional use of the weaker Counter-A, with increases in Counter-C, with a continuous upward trend. Even by the curriculum end, students do not show evidence of plateaus in argument strategies, but continue to improve in argumentation. Delays in improvement, combined with trajectories showing potential for further improvement make a strong case for continued, long-term intervention for this population of students.

Critically, outcomes for students in the present study highlight educational disparities and provide insight regarding differential outcomes for students from disadvantaged backgrounds. The focus on argumentation skills appears explicitly, not only in grade school curriculum standards (CORE), but in entrance exams like the SAT, Graduate Record Examination (GRE) and Law School Admissions Test (LSAT), (College Board, 2016; Educational Testing Services, 2003; Law School Admissions Council, 2008). Just one such example: in an announcement of changes to the SAT as of March 2016, three new important features are listed, the first of which is "emphasis on reasoning skills" (College Board, 2016). Argumentation interventions have the potential to mitigate negative long-term outcomes with significant consequences, playing an equalizing role for at-risk adolescents.

Limitations and Future Directions

Findings from the present research reflect effects specific to the conditions of this study, allowing for limited generalizability. Results are confined to the context of the study design, including the definition of expert by strategies used, and topics covered. Generalizability is also restricted by population, due to the particular socioeconomic characteristics of the community of students sampled.

The present study design was limited in its control of any crossed effects between treatment and comparison conditions. Treatment involved students in the expert condition engaging in alternating dialogs with experts and peers. While only expert group students directly interacted with experts, those same students engaged in subsequent dialogs with peers in the comparison group. With the improvement in argument strategy shown by the expert group, over time any dialogs between pairs of comparison and treatment group students can be considered asymmetrical, so it is difficult to separate attributions of improvements in argumentation for peer group students to the curriculum more generally, or to argumentation with more capable peers. Future study design may restrict peer dialogs between same-group dyads, so as to examine effects without any potential crossing between peer and expert conditions.

Analysis for the present study was limited by the fact that students engaged in dialogs in pairs, changing pair partners in each of four topics. For this reason, effects for individual students were not able to be analyzed statistically, outside of the individually conducted transfer task, and statistical analysis of effects for student pairs over the total study time was limited, as pairs were not consistent across topics. This problem is inherent in research on collaborative work in dyads. Changing pairs for each topic is valuable practically, in avoiding interpersonal conflict between middle school adolescents and, empirically, in ensuring that any interpersonal conflicts or other issues that arise from a particular pairing are not lasting for any individual student over the entire study time. It was also necessary to do so as to pair students that shared the same position on a a topic.

Much of the work on cognitive development in a social, collaborative context focuses on the social relationship between learners in a collaborative environment. When examining varying levels of competency, theories stem from the traditional Vygotskian focus on benefit from adult-child pairings, and Piagetian focus on benefit from child-child pairings. The present study not only employs child-child pairings of peer dyads to create conditions for social learning, but also uniquely uses child-adult pairing while maintaining the illusion of a socially symmetrical child-child relationship, as the electronic medium allowed students in the expert condition to believe they were engaged in dialog against another peer dyad. Future research may examine effects of students' perceptions of the expert to consider whether the belief that experts were peers rather than adults influenced the treatment.

Dialogs between students and experts were not included in analysis for the present study, as the research questions centered on effects for students in their peer dyad dialogs. Vygotsky argued, however, that proximal development was witnessed most in tasks involving collaboration between experts and students, so examination of those dialogs may reveal interesting trends beyond those found in peer dialog.

Future research may further examine transfer effects, as prior studies indicate stronger transfer effects, generally, for students learning by expert modeling rather than direct instruction (Greeno, 1997; Pedersen & Liu, 2003). Such effects may specifically include those previously found in the context of the argumentation curriculum. Effects of transfer for students in the expert condition may include student essays, as increase in direct critiques in dialog has been previously found to transfer to written argument (Kuhn & Crowell, 2011), improved use of evidence (Kuhn & Moore, 2015) and metacognitive or metastrategic advances (Kuhn, Goh, Iordanou, & Shaenfield, 2008; de Leeuw & Chi, 2003).

CONCLUSION

Education is a subject of much concern for today's society, with a great deal of policy aimed at improving educational outcomes for youth, and ensuring that schools are preparing students to be socially and professionally competent adults. However, the traditional approach of teaching through rote memorization of material and regurgitation on exams misses the fundamental underlying goal of education, which is development through intellectual engagement and critical thought. This is reflected in a society that is increasingly polarized, avoiding dialog around issues involving reasoned arguments for one position or another. Cognitive outcomes must be improved, even for students successful in progressing through their education, as many young adults still lacking epistemological understanding.

This is particularly true for underprivileged youth, who are typically excluded from curriculum involving cognitive skills like inquiry and analysis. These students largely come from communities and families where focus must be centered on basic needs, rather than intellectual curiosity and largely attend schools that focus on basic skill development for performance on standardized tests. Outcomes for these students create a cyclical pattern of disadvantage lasting through generations.

Argumentation provides a clear pathway for students to practice and develop higher-order cognitive skills, through social and collaborative engagement with peers and teachers. It is in such a context that students have the opportunity to be a part of a community of learners, fostering shared intellectual values and curiosities, and encouraging critique through questions and reasoning. Through the collaborative learning environment created by the dialogic argumentation curriculum, students develop metacognitively, learning through a natural social process. As was the case for Sonia Sotomayor, growing up a young girl in the Bronx, development of skilled argumentation has the potential to level the disparities for underprivileged youth, who are not often otherwise exposed to critical thinking, or encouraged to challenge, and ask questions.

While particularly true for disadvantaged populations, argumentation is a skill which fundamentally affords all students critical perspectives on knowledge and learning. Effects of argumentation persist well beyond students improved cognition in the context of dialog and debate, but through an individual's lifespan, by allowing for a fundamental base of understanding about the process of reasoning and persuasion, which can be applied across academic, professional, and social contexts. Through argumentation, the ultimate goal of education can be accomplished: teaching students not what to think, but how to think.

References

Alves, P. F. (2014). Vygotsky and Piaget: scientific concepts. *Psychology in Russia. State of the Art*, *7*(3).

Anderson, R. C., Nguyen-Jahiel, K., McNurlen, B., Archodidou, A., Kim, S. and Reznitskaya, A. (2001). The snowball phenomenon: Spread of ways of talking and ways of thinking across groups of children. Cognition and Instruction, 19, 1–46.

Asterhan, C. S., & Schwarz, B. B. (2007). The effects of monological and dialogical argumentation on concept learning in evolutionary theory. *Journal of Educational Psychology*, *99*(3), 626.

Asterhan, C. S., & Schwarz, B. B. (2009). Argumentation and explanation in conceptual change: Indications from protocol analyses of peer‐to‐peer dialog. *Cognitive science*, *33*(3), 374-400.

Bereiter, C., & Scardamalia, M. (2013). *The psychology of written composition*. Routledge.

Brown, A. L., & Campione, J. C. (1990). Interactive learning environments and the teaching of science and mathematics. *Toward a scientific practice of science education*, 111-139.

Brown, A. L., & Palincsar, A. S. (1989). Guided, cooperative learning and individual knowledge acquisition. *Knowing, learning, and instruction: Essays in honor of Robert Glaser*, 393-451.

College Board. (2016). https://collegereadiness.collegeboard.org/sat/

Common Core State Standards Initiative. (2012). http://www.corestandards.org/

Collins, A., Brown, J. S., & Holum, A. (1991). Cognitive apprenticeship: Making thinking visible. *American educator*, *15*(3), 6-11.

Crowell, A. & Kuhn, D. (2014). The development of argumentation skills: A 3-year intervention study. *Journal of Cognition and Development, 15 (2),* 363-381.

De Leeuw, N., & Chi, M. T. H. (2003). The role of self-explanation in conceptual change learning. *Intentional conceptual change*, 55-78.

Dean Jr, D., & Kuhn, D. (2007). Direct instruction vs. discovery: The long view. *Science Education*, *91*(3), 384-397.

Felton, M., & Kuhn, D. (2001). The development of argumentive discourse skills. *Discourse Processes, 32,* 135-153.

Greeno, J. G. (1989). A perspective on thinking. *American psychologist*, *44*(2), 134.

Greeno, J. G. (1997). On claims that answer the wrong questions. *Educational researcher*, *26*(1), 5-17.

Iordanou, K. (2013). Developing face-to-face argumentation skills: Does arguing on the computer help. Journal of Cognition and Development, 14, 292-320.

Jucks, R., & Paus, E. (2013). Different words for the Same Concept: Learning collaboratively from Multiple Documents. Cognition and Instruction, 31(2), 1-28.

Kim, I., Anderson, R. C., Kim N.J. and Archodidou. A. (2007). Discourse Patterns During Children's Collaborative Online Discussions. Journal of the Learning Sciences, 16 (3), 333-370.

Kuhn, D. (1991). *The skills of argument.* Cambridge: Cambridge University Press.

Kuhn, D., & Crowell, A. (2011). Dialogic argumentation as a vehicle for developing young adolescents' thinking. *Psychological Science*, *22*(4), 545-552.

Kuhn, D., Goh, W., Iordanou, K., & Shaenfield, D. (2008). Arguing on the Computer: A Microgenetic Study of Developing Argument Skills in a Computer‐Supported Environment. *Child Development*, *79*(5), 1310-1328.

Kuhn, D., Hemberger, L., & Khait, V. (2014). *Argue with me: Argument as a path to developing students' thinking and writing*. New York: Wessex Inc.

Kuhn, D., & Moore, W. (2014). Argument as core curriculum. Learning: Research and practice, 1.

Kuhn, D., Wang, Y. & Li, H. (2011). Why argue? Developing understanding of the purpose and values of argumentive disocurse. *Discourse Processes, 48*, 26-49.

Kuhn, D., Zillmer, N., Crowell, A., & Zavala, J. (2013). Developing norms of argumentation: metacognitive, epistemological, and social dimensions of developing argumentive competence. *Cognition and Instruction*, *31*(4), 456-496.

Macagno, F., Mayweg-Paus, E., & Kuhn, D. (2014). Argumentation Theory in Education Studies: Coding and Improving Students' Argumentative Strategies. *Topoi*, 1-15.

Mayweg-Paus, E., Macagno, F., & Kuhn, D. (2015). Developing Argumentation Strategies in Electronic Dialogs: Is Modeling Effective?. *Discourse Processes*, (2015).

Mason, J. (1996). Invoking children's powers of mathematical thinking. *Employing children's natural powers to build algebraic reasoning in the content of elementary mathematics. Hillsdale, NJ: Lawrence Erlbaum.*

Nussbaum, E. M. (2008). Collaborative discourse, argumentation, and learning: Preface and literature review. *Contemporary Educational Psychology*, *33*(3), 345-359.

Palinscar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and instruction*, *1*(2), 117-175.

Pedersen, S., & Liu, M. (2002). The transfer of problem-solving skills from a problem-based learning environment: The effect of modeling an expert's cognitive processes. *Journal of Research on Computing in Education*, *35*(2), 303-320.

Pedersen, S., & Liu, M. (2003). Teachers' beliefs about issues in the implementation of a student-centered learning environment. *Educational Technology Research and Development*, *51*(2), 57-76.

Pollock, J. L. (1974). Knowledge and Justification. Princeton: Princeton University Press.

Pollock, J. L. (1987). Defeasible reasoning. Cognitive Science, 11, 481–518.

Rogoff, B. (1994). Developing understanding of the idea of communities of learners. *Mind, culture, and activity*, *1*(4), 209-229.

Sotomayor, S. (2013). *My beloved world*. New York: Alfred a Knopf Incorporated.

U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2011 Writing Assessment.

van Eemeren, F.H., & Grootendorst, R. (1992). Argumentation, communication, and fallacies: A pragma-dialectical perspective. Hillsdale, NJ: Lawrence Erlbaum Associates.

van Eemeren, F.H., & Grootendorst, R. (2004). A systematic theory of argumentation. The pragma-dialectical approach. Cambridge: Cambridge University Press.

Vygotsky, L. S. (1978). Mind in Society: the development of higher psychological processes. M. Cole, V. John-Steiner, S., Scribner, E. Souberman (Eds). Oxford, England: Harvard University Press.

Walton, D. (2005). How to evaluate argumentation using schemes, diagrams, critical questions and dialogs. *M. Dascal et al.(Eds.). Argumentation in Dialogic Interaction. Studies in Communication Sciences Special*, (51-74).

Walton, D. (2006). Fundamentals of Critical Argumentation. New York: Cambridge University Press.

Walton, D. (2007). Metadialogs for Resolving Burden of Proof Disputes. Argumentation, 21, 291-316.

Walton, D., Reed, C., & Macagno, F. (2008). Argumentation Schemes. New York: Cambridge University Press.

Wertsch, J. V. (1991). A sociocultural approach to socially shared cognition. In L. B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), Perspectives on socially shared cognition (pp. 85–100). Washington, DC: American Psychological Association

APPENDIX A: ARGUMENT CURRICICULUM CYCLE PER TOPIC:

Table 1. The argumentation curriculum workflow cycle of activities completed per topic.

	Class Sessions:	In class activity:
Pregame: Small Group Work	1	Generating, sharing & thinking
	2	Finalizing & evaluating our reasons
The Game: Paired Dialogs	3	Paired same-side peer groups engage in an electronic dialog with an opposing same-side peer pair. Dueling opposite side pair group dialogs rotate for every class session.
	4	
	5	
	6	
	7	
	8	
Endgame: Small Group Work	9	Preparing to counter others' reasons
	10	Preparing to rebut others' counters to our reasons
Entire Class	11	Showdown-whole class debate
	12	Showdown debrief
	13	Essay pre-writing activity

APPENDIX B: DETAILED TOPIC SCENARIOS FOR ALL FOUR TOPICS

TOPIC 1 SCENARIO:

Imagine you are forming a new town in an undeveloped area. It will be called ColumbiaTown. Decisions must be made about how the town will work. We ask you to consider the case of Nick. ColumbiaTown has a good school that the parents and students are happy with. All of the children in our town attend this school through high school. Since the houses are far apart, school gives children a chance to be together.

A problem has come up! The Costa family has moved to the edge of town from far away Greece with their 11-year-old son, Nick. Nick's parents are both teachers, and in Greece they were keeping him at home and teaching him themselves. Nick was a good student and good soccer player in Greece and his parents have decided that in ColumbiaTown, they want to keep Nick at home with them, and not have him at the school with the other children. The family speaks only Greek, and they think Nick will do better if he sticks to his family's language, and doesn't have to do his schoolwork in English. They say they can teach him everything he needs at home. As a town, we must decide what to allow: **Question: Is it okay for the Costa family to live in the town but keep Nick at home, or should they send their son to the town school like all the other families do?**

Please vote by circling one option:

Home school okay   Nick must go to town school   Undecided

TOPIC 2 SCENARIO:

A poor Asian country is being invaded by a neighboring country. The United States is considering whether to send soldiers to help. The US is not sure it has enough soldiers available to send and is concerned about the cost in dollars and lives. Throughout its history, the US has had to decide whether to involve itself in another country's problems. Some think the US should act in these situations. Others think we should use our resources on our own serious problems at home. **Question: Should the US get involved or not get involved?**

Please vote by circling one option:

Yes, the U.S. should get involved   No, the U.S. should not get involved   Undecided

TOPIC 3 SCENARIO:

Teens who commit serious crimes maybe tried and sentenced in the adult court system. Or they maybe tried in a court system for juveniles. ***Question: Which is better?***

Please vote by circling one option:

Juvenile Court System   Adult Court System   Undecided

TOPIC 4 SCENARIO:

Humans have two kidneys. They need at least one working kidney to live. If both their kidneys stop working, it is possible for them to get a transplanted kidney from someone who is willing to give up one of their kidneys. But new kidneys are in short supply; people needing them often have to wait years. A poor couple heard that a man will pay them $10,000 to sell him a kidney to save the life of his 12-year-old son. The husband wants to do it because they need the money, but the wife is unsure because it would be her kidney they would sell to the man and she is afraid it could cause problems. Should people be allowed to take money for their kidneys or should this be forbidden?
Question: **Should people be allowed to take money for their kidneys or should this be forbidden?**

Please vote by circling one option:

OPTION # 1— Selling one of your kidneys for money is okay
OPTION # 2— Human organs like kidneys can be donated for free but not sold for money
OPTION # 3— Undecided

APPENDIX C: SAMPLE REFLECTION SHEET

"OWN" REFLECTION SHEET

Team members ____

Date ____________________

Let's think...Starting with our argument

One of our MAIN ARGUMENTS was:

Their COUNTERARGUMENT against our argument was:

Our COMEBACK was:

How can this COMEBACK be improved? Is there a more effective comeback?

APPENDIX D: SAMPLE SHOWDOWN TRANSCRIPT

From Topic 1 Showdown- Rounds 1 and 2 (out of 8)

Round 1				
Row	***Home School***	***Town School***	***Strategy***	***Comments***
1		Nick should go to town school because he has a lot of opportunities to do more things.	New idea	
2	Well, Nick could play sports, which will give him a lot of opportunities to play professional soccer.		Counter	(+1)
3		He can he only play professional soccer in school cause if he plays alone at his house he will be like lonely and has no one to play with	Unwarranted assumption	
4	Can you say that again?		Clarify	Tell them asking for clarify is always fine
5		I said that Nick could play professional soccer only in a school cause when he is at home he is so lonely.	Repeat	
6	HUDDLE called		Huddle	
7	So he can play soccer with his neighborhood and he could play soccer with YMCA		Counter + Evidence	(+1) + (+1)
8		But why would he play with strangers if he doesn't even know those people. Plus when he goes to school…well…when he studies at home he has more distractions like with his video games something like that. But when he goes to school the teachers can really like push him to do more work.	Counter + New idea	(+1) good strategy - counter, then new idea
9	But he can join a soccer team so…		Unsuccessful counter	
10		That's….well doesn't know those people and when if he plays…hey dude, listen…and when he plays in school he can meet new friends in his soccer team. Playing with his neighbors it's like he doesn't even know anyone. And it doesn't say that he lives with people next to him. Something like that.	Counter	(+1)
11	Uhm…well…maybe, maybe in his town there might Greek people.		Unwarranted assumption	
12		But….		
Round 2				
Row	***Home School***	***Town School***	***Strategy***	***Comments***
13		But if he goes to town school he could have different teachers can learn faster English	New idea	
14	Okay, but it is very easy to learn second language.		Counter	(+1) Might this be a good place to have some evidence to support? (Missed opportunity to use exact evidence)
15		Well, how is he gonna learn English if his friends don't speak English.	New idea	
16	Okay, I understand that but maybe he can go somewhere to learn English, he doesn't have to necessarily go to school		Counter	(+1)
17		Where did you go?	Unsuccessful counter	This is an unsuccessful counter as any answer wouldn't weaken the point made in 16
18	Maybe he can go to the school but not be in the school, maybe after school, maybe the school has after-school activities that he could go to speak English.		Counter	(+1)
19		He is still going to school?	Counter	(+1)

20	Exactly, but he is not, he is only learning English. He is not learning academics. So he only learns English.		Unsuccessful counter	
21		But he will have all these opportunities if he goes to school.	Counter	(+1)
22	I KNOW that, but he is only learning English. He is not learning math, science. His parents are teaching him math cause he is being homeschooled, not going to town school.		Unwarranted assumption	
23		Probably he can play soccer with his friends, he has friends.	Unconnected	How does this address what was said in line 22?
24	Okay, if he doesn't have friends, which he doesn't because he is new, he can play with his parents and…oh, speak…		Counter	(+1)
25		But his parents are very old.	Unwarranted assumption	
26	They can pass. Or maybe he has friends in Greece so maybe he can communicate with them online.		Unsuccessful counter	
27		Well but how could he play soccer with them?	Counter	(+1)
28	He could invite them.		Unsuccessful counter	
29		All the way to Greece from America?	Counter	(+1) Good challenge; it's a counter in the form of a Q
30	Yes		Unsuccessful counter	
31		Really?	Clarify	
32	Yes		Unsuccessful counter	
33		HUDDLE called	Huddle	
34		Uhm his friends uhm only come uhm just play with him with all that money?	Unsuccessful counter	
35	Okay let's say they didn't go, his parents can play with him.		Repeat	
36		But they are very old.	Repeat	
37	How do you know their age?		Counter	(+1)
38		How do you know their age?	Repeat	
39	How do you know cause you are just saying they are very old.		Counter	(+1)
40		Cause they are teachers, to become teachers you have to be old.	Unwarranted assumption	Good attempt to provide evidence; but is it correct?

APPENDIX E: TRANSFER TASK- CAPITAL PUNISHMENT SCENARIO

Capital punishment, also called the death penalty, is the practice of putting someone to death for committing a serious crime, like murder. Being **FOR** Capital punishment means that you think that someone who has committed a serious crime like murder should be put to death. Being **AGAINST** capital punishment means that you think someone who committed a serious crime like murder should not be put to death.

Question: Are you for or against capital punishment? (Circle one)

For **Against** **Undecided**

How sure are you about your opinion? (Circle One)

Certain Very Sure Sure So-so Not very sure Not sure at all

APPENDIX F: CODING SCHEME USED TO IDENTIFY COUNTER A, C, AND UNDERMINER

Category (Code)	Description of Category
Counter-Critique (Counter C)	Rebutting the interlocutor's argument by attacking its conclusion, showing it cannot be accepted. For instance, the arguer can point out the negative consequences of the conclusion.
Counter-Alternative (Counter A)	Attacking a position advancing an alternative argument that leaves the opponent's argument unaddressed.
Underminer	Attacking the interlocutor's argument by showing that the conclusion does not follow from the premises, or that one of the premises is not acceptable. Critical questions can also serve this purpose.

APPENDIX G: Topic 1 - Advanced Strategy Analysis: Tables and Figures

POOLED ANOVA TABLE:

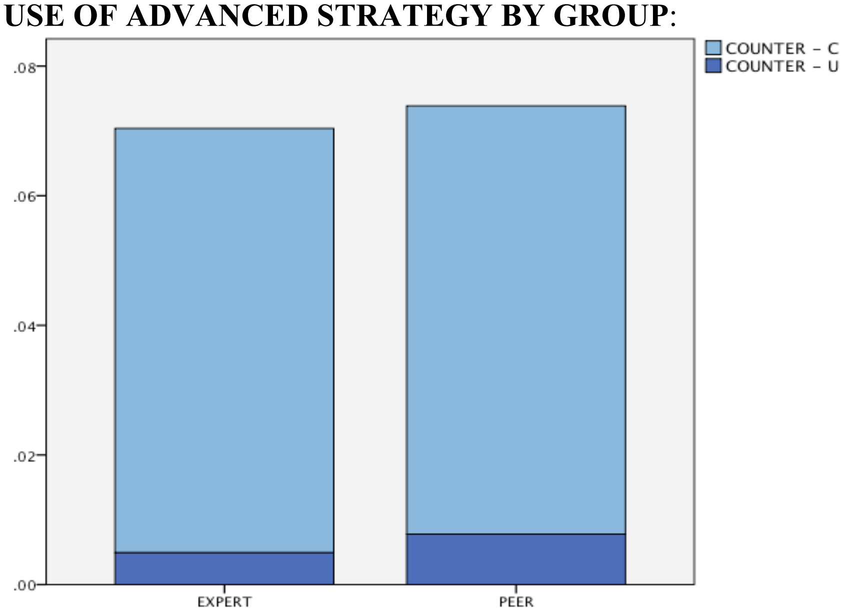
Source:	SS	df	MS	F	Sig.	Partial Eta Sq
BETWEEN						
GROUP	1.400E-7	1	1.400E-7	.000	.997	.000
Error	.279	22	.013			
WITHIN						
TIME	.010	2	.005	.480	.622	.021
TIME* GROUP	.007	2	.003	.351	.706	.016
Error(TIMECA)	.438	44	.010			

MEAN PROPORTION OF ADVANCED STRATEGIES BY GROUP AND TIME:

	Treatment Group "EXPERT"	Comparison Group "PEER"	All Participants
DIALOG 1:	.096 (.133)	.069 (.112)	.082 (.121)
DIALOG 2:	.057 (.093)	.076 (.081)	.066 (.086)
DIALOG 3:	.050 (.090)	0.058 (.106)	.054 (.097)

(Standard Deviations are in Parentheses)

PROPORTION USE OF ADVANCED STRATEGY BY GROUP:



TOPIC 1 – PROPORTION OF ADVANCED STRATEGIES

Topic 1- Individual Counterargument Strategies (A, C, U)

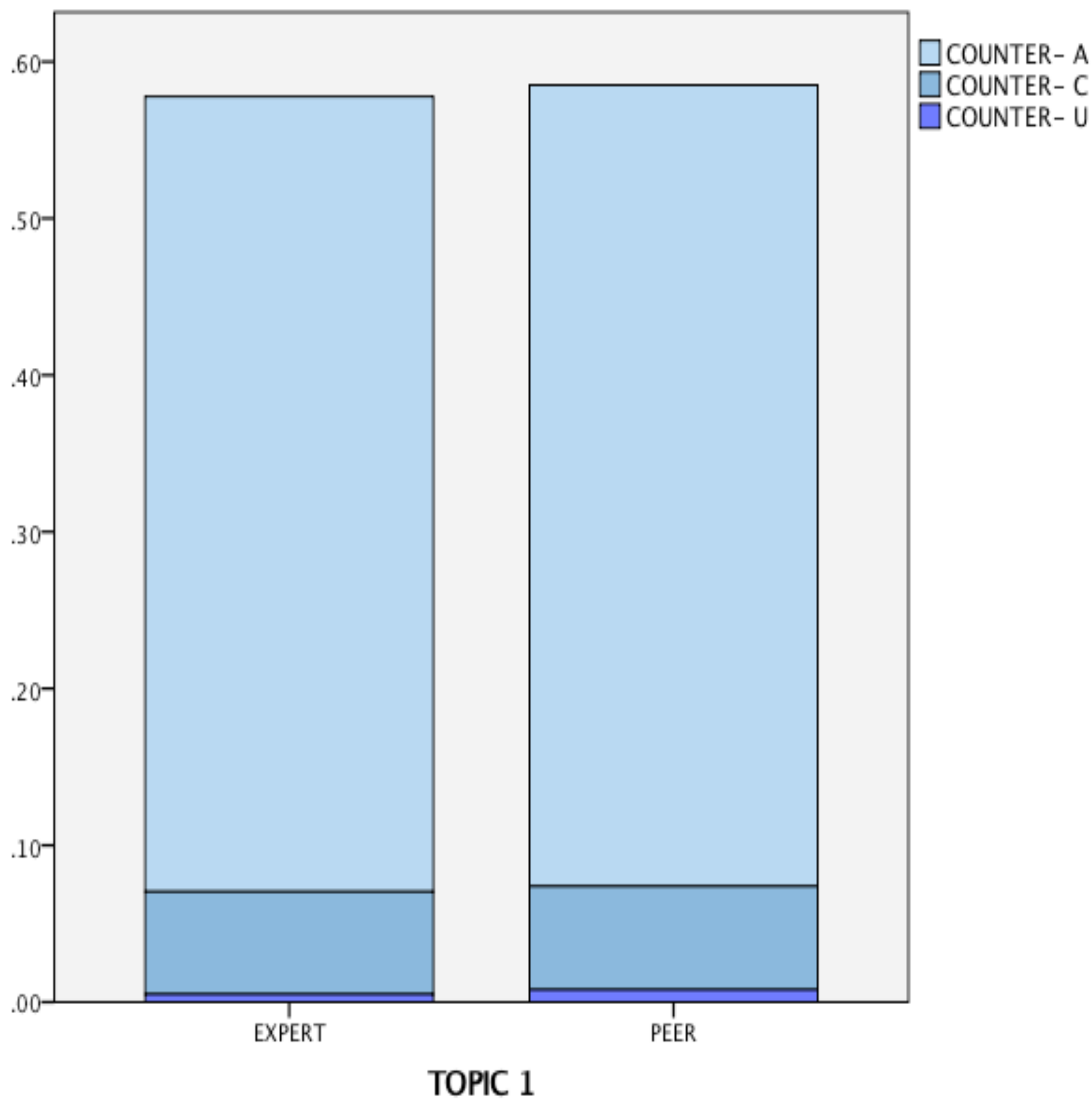
Proportional Means for Type of Counterargument (A, C, U) by Group and Time:

Counter- A		MEAN	STD DEV
T1 total		**0.447**	**0.15**
	expert	0.435	0.148
	peer	0.460	0.158
T2 total		**0.519**	**0.19**
	expert	0.529	0.214
	peer	0.509	0.171
T3 total		**0.556**	**0.183**
	expert	0.556	0.182
	peer	0.556	0.193

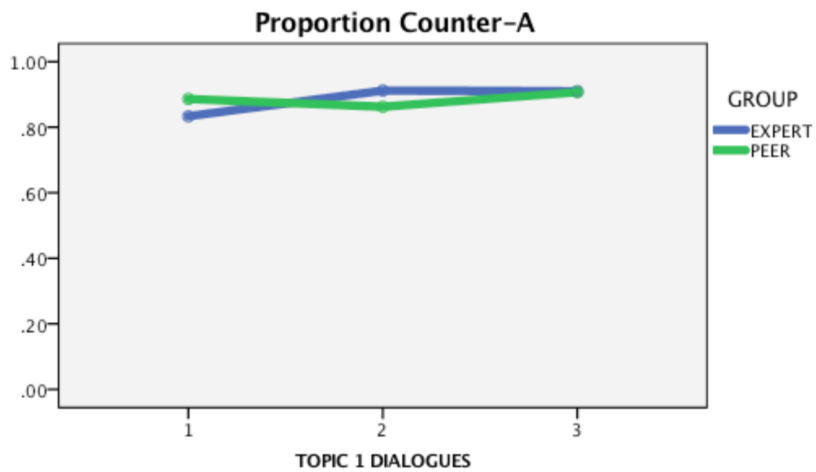
Counter- C		MEAN	STD DEV
T1 total		**0.075**	**0.11**
	expert	0.096	0.133
	peer	0.055	0.083
T2 total		**0.058**	**0.084**
	expert	0.045	0.091
	peer	0.070	0.079
T3 total		**0.054**	**0.097**
	expert	0.05	0.026
	peer	0.058	0.106

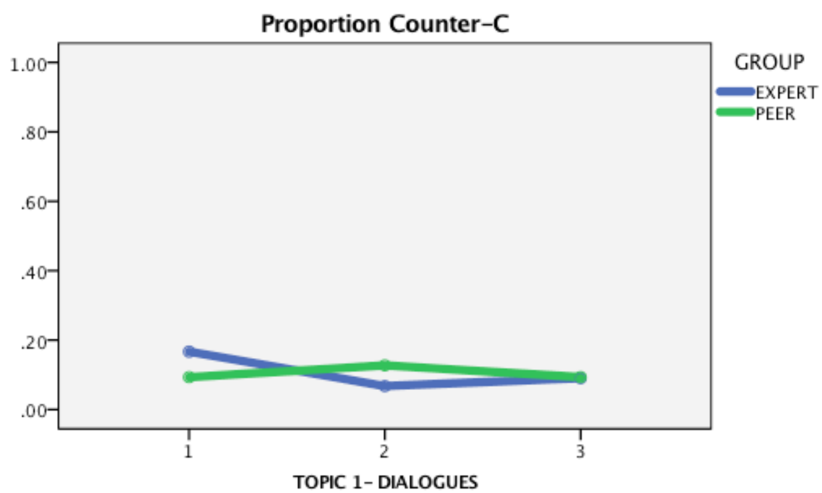
Counter -U		MEAN	STD DEV
T1 total		**0.007**	**0.034**
	expert	0	0
	peer	0.014	0.048
T2 total		**0.009**	**0.032**
	expert	0.012	0.041
	peer	0.006	0.019
T3 total		**0**	**0**
	expert	0	0
	peer	0	0

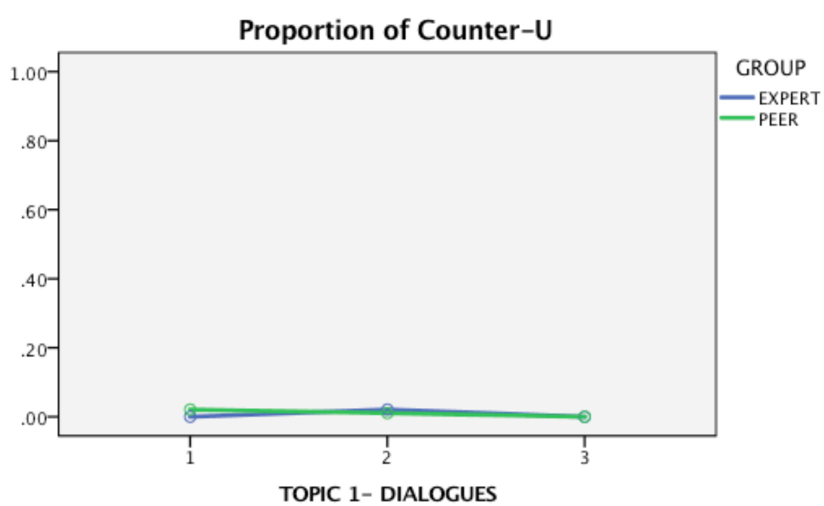
Topic 1 - Proportion Use of Counter A, C, U by Group



Topic 1- Proportion Use of Counter A, C, U Individually Across Topic 1 Time Points







APPENDIX H: Topic 2 - Advanced Strategy Analysis: Tables and Figures

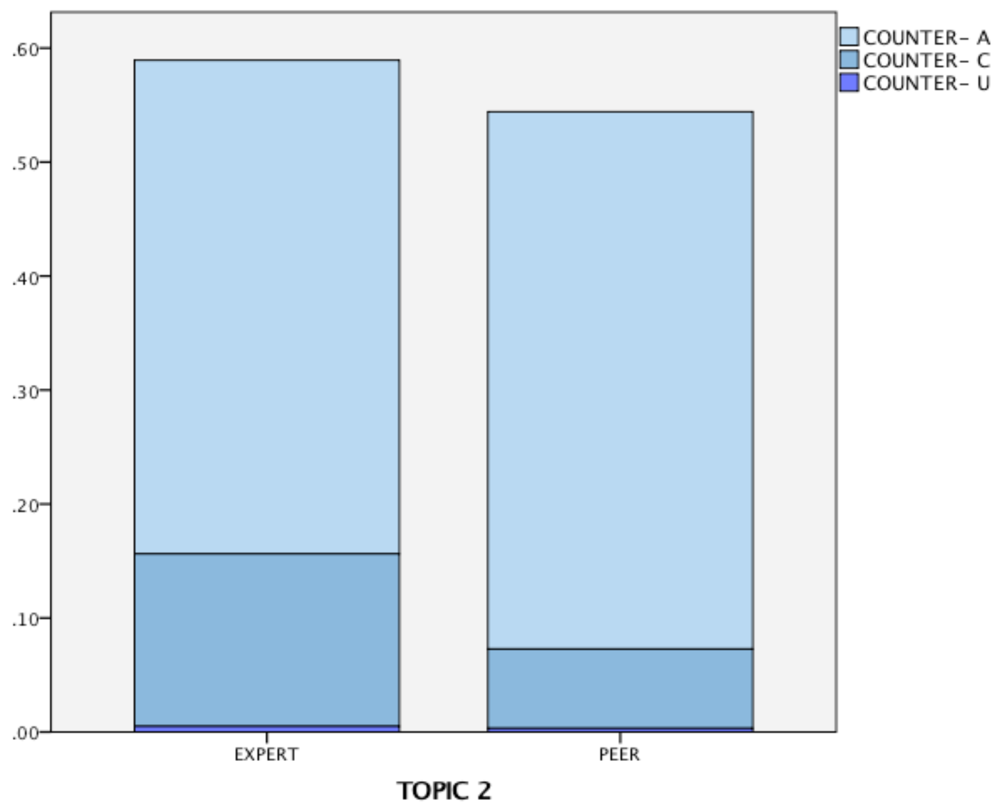
POOLED ANOVA

Source:	SS	df	MS	F	Sig.	Partial Eta Sq
BETWEEN						
GROUP	.083	1	.083	4.120	.055	.158
Error	.444	22	.20			
WITHIN						
TIME	.135	2	.067	4.157	.022*	.159
TIME* GROUP	.077	2	.038	2.370	.105	.097
Error(TIMECA)	.713	44	.010			

MEAN PROPORTION OF ADVANCED STRATEGIES BY GROUP AND TIME:

	Treatment Group "EXPERT"	Comparison Group "PEER"	All Participants
DIALOG 1:	.084 (.124)	.061 (.089)	.072 (.106)
DIALOG 2:	.094 (.145)	.074 (.119)	.084 (.13)
DIALOG 3:	.250 (.18)	.089 (.12)	.17 (.17)

PROPORTIONAL USE OF ARGUMENT STRATEGY TYPES BY GROUP



Topic 2- Individual Counterargument Strategies (A, C, U)

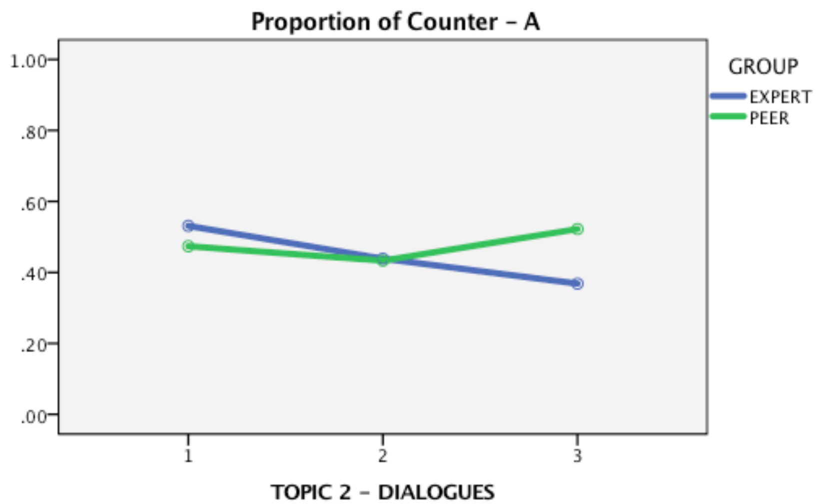
Proportional Means for Type of Counterargument (A, C, U) by Group and Time:

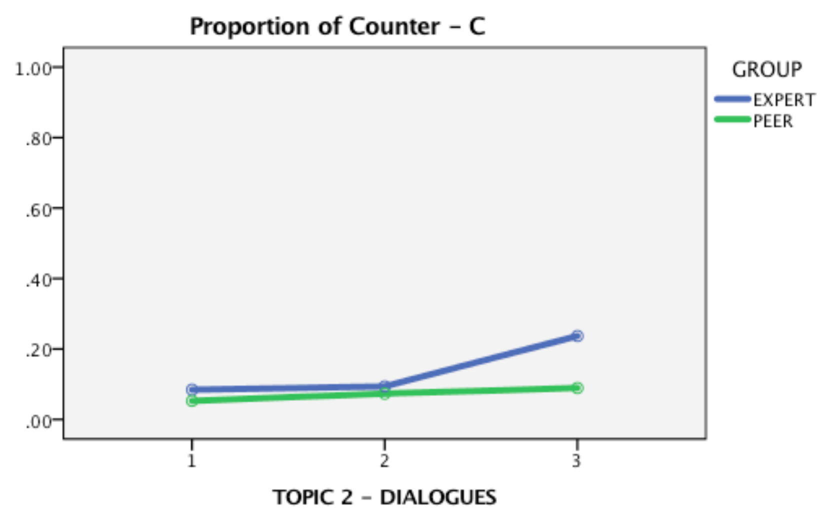
Counter- A		MEAN	STD DEV
T1 total		**0.503**	**0.132**
	expert	0.531	0.133
	peer	0.474	0.13
T2 total		**0.436**	**0.209**
	expert	0.439	0.213
	peer	0.433	0.214
T3 total		**0.445**	**0.189**
	expert	0.369	0.144
	peer	0.522	0.202

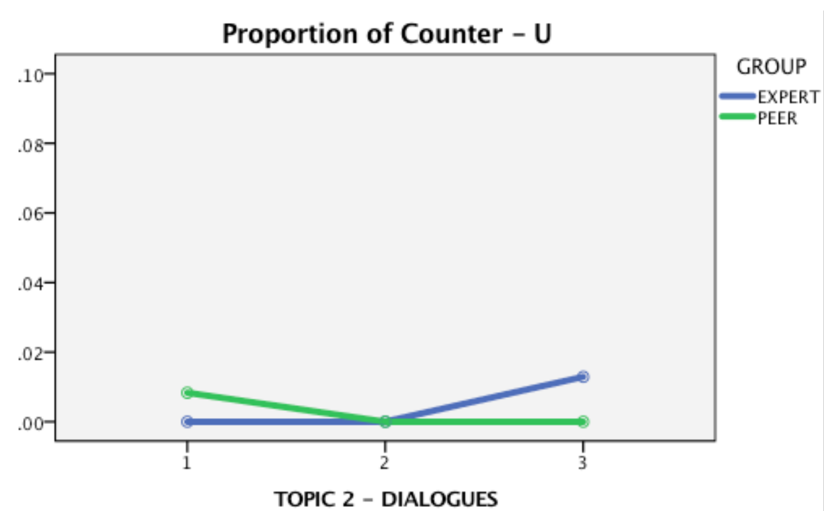
Counter- C		MEAN	STD DEV
T1 total		**0.069**	**0.107**
	expert	0.084	0.124
	peer	0.053	0.09
T2 total		**0.084**	**0.13**
	expert	0.094	0.145
	peer	0.074	0.119
T3 total		**0.163**	**0.166**
	expert	0.237	0.176
	peer	0.089	0.12

Counter -U		MEAN	STD DEV
T1 total		**0.004**	**0.02**
	expert	0	0
	peer	0.008	0.029
T2 total		**0**	**0**
	expert	0	0
	peer	0	0
T3 total		**0.006**	**0.022**
	expert	0.0129	0.03
	peer	0	0

Topic 2- Proportion Use of Counter A, C, U Individually across Topic 2 Time Points







APPENDIX I: Topic 3 - Advanced Strategy Analysis: Tables and Figures

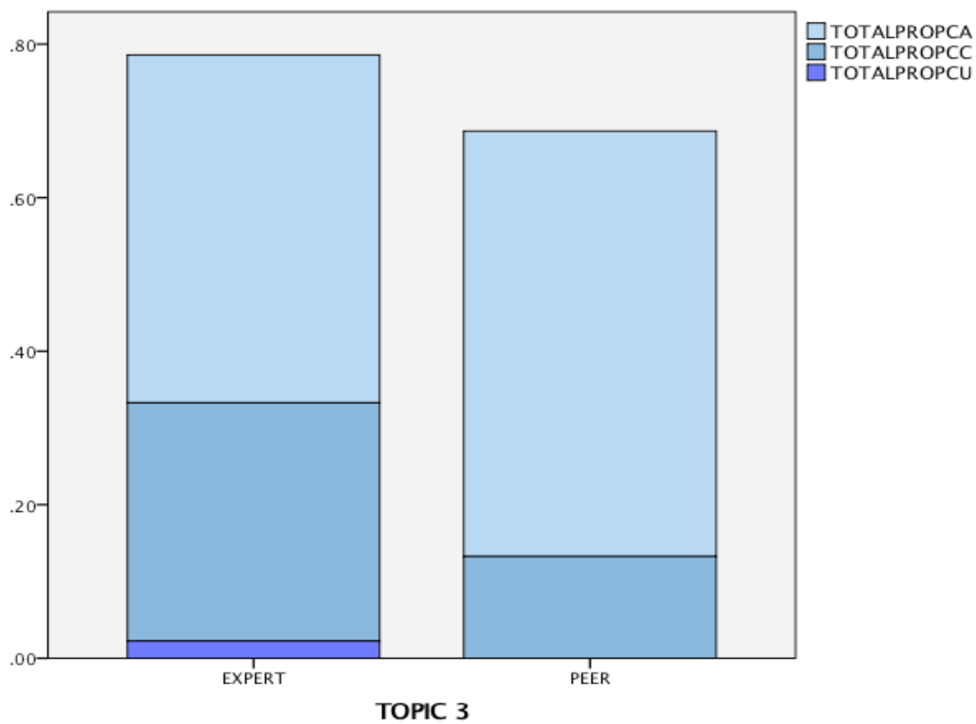
POOLED ANOVA

Source:	SS	df	MS	F	Sig.	Partial Eta Sq
BETWEEN						
GROUP	.718	1	.718	19.265	.000*	.467
Error	.820	22	.037			
WITHIN						
TIME	.098	2	.049	2.806	.071	.113
TIME* GROUP	.014	2	.007	.405	.669	.018
Error(TIMECA)	.766	44	.017			

MEAN PROPORTION OF ADVANCED STRATEGIES BY GROUP AND TIME:

	Treatment Group "EXPERT"	Comparison Group "PEER"	All Participants
DIALOG 1:	.276 (.131)	.093 (.122)	0.184 (.155)
DIALOG 2:	.383 (.159)	.144 (.163)	.263 (.199)
DIALOG 3:	.350 (.184)	.173 (.164)	.262 (.193)

PROPORTIONAL USE OF ARGUMENT STRATEGY TYPES BY GROUP



Topic 3- Individual Counterargument Strategies (A, C, U)

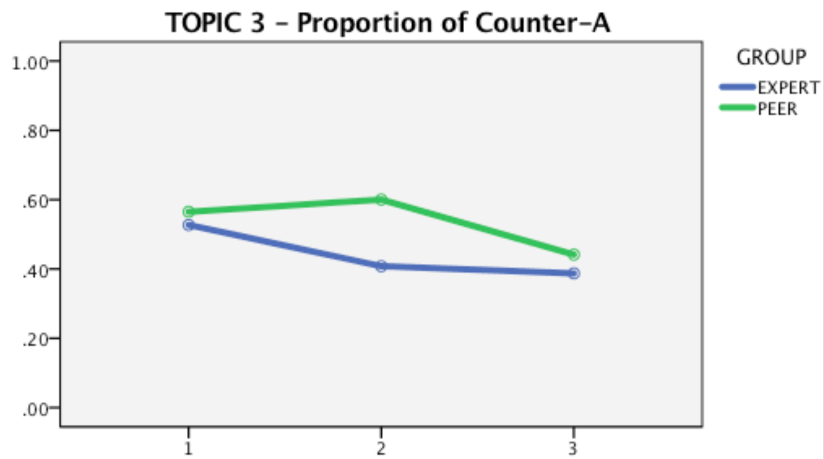
Proportional Means for Type of Counterargument (A, C, U) by Group and Time:

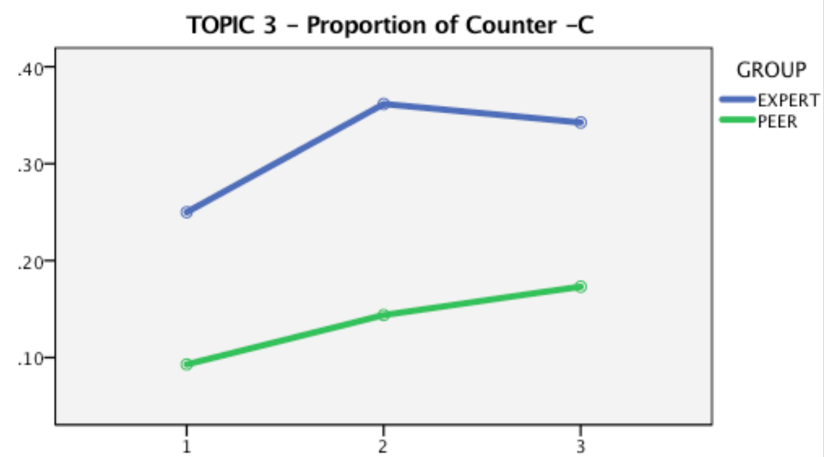
Counter- A		MEAN	STD DEV
T1 total		**0.546**	**0.126**
	expert	0.527	0.134
	peer	0.565	0.12
T2 total		**0.504**	**0.21**
	expert	0.408	0.16
	peer	0.6	0.215
T3 total		**0.414**	**0.165**
	expert	0.387	0.124
	peer	0.442	0.2

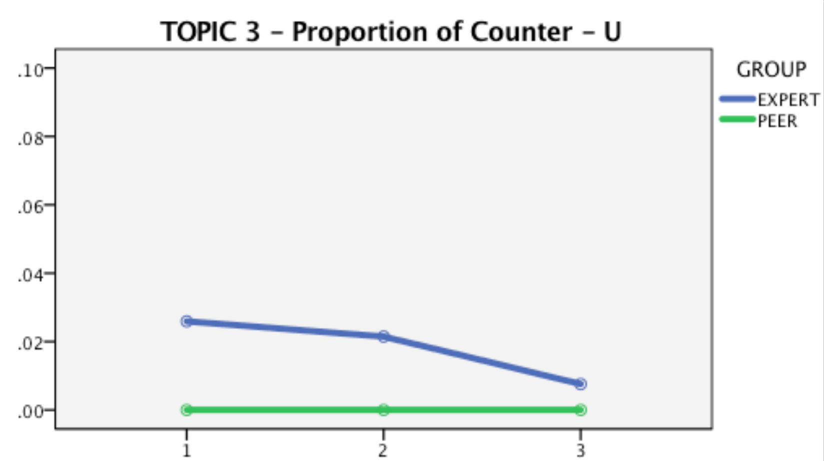
Counter- C		MEAN	STD DEV
T1 total		**0.171**	**0.138**
	expert	0.25	0.106
	peer	0.093	0.123
T2 total		**0.253**	**0.19**
	expert	0.362	0.152
	peer	0.144	0.163
T3 total		**0.258**	**0.193**
	expert	0.343	0.189
	peer	0.173	0.164

Counter -U		MEAN	STD DEV
T1 total		**0.013**	**0.035**
	expert	0.023	0.047
	peer	0	0
T2 total		**0.0107**	**0.038**
	expert	0.022	0.053
	peer	0	0
T3 total		**0.004**	**0.019**
	expert	0.008	0.026
	peer	0	0

Topic 3: Proportion Use of Counter A, C, U Individually Across Topic 3 Time Points







APPENDIX J: Topic 4 - Advanced Strategy Analysis: Tables and Figures

POOLED ANOVA

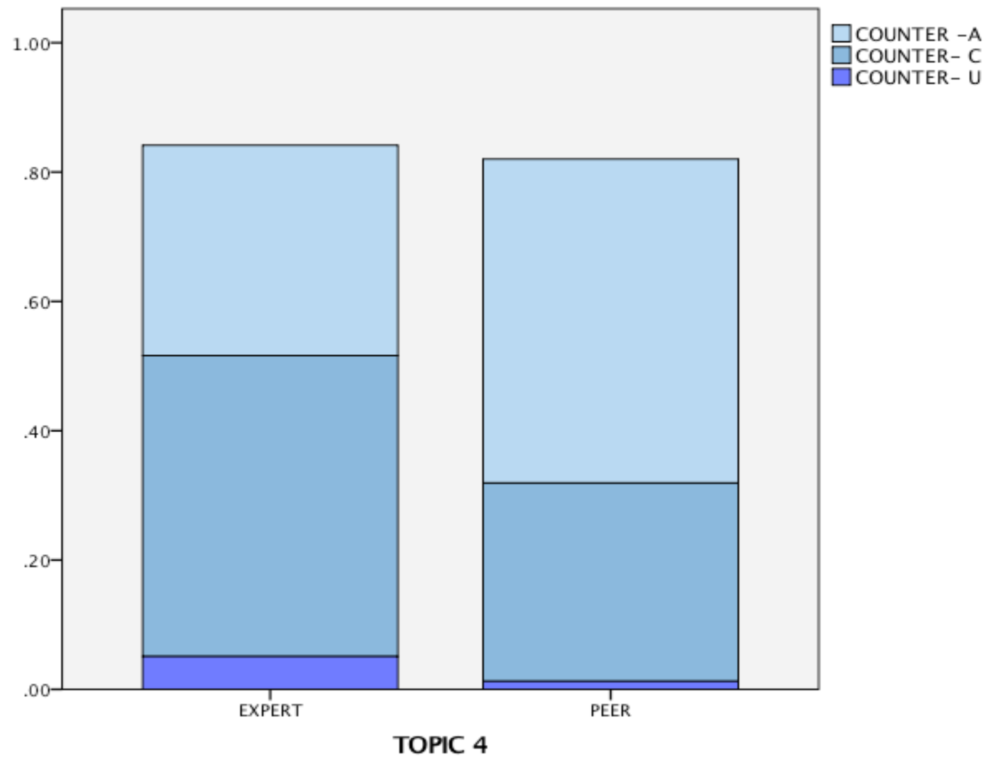
Source:	SS	df	MS	F	Sig.	Partial Eta Sq
BETWEEN						
GROUP	.740	1	.740	28.398	.000*	.563
Error	.573	22	.026			
WITHIN						
TIME	.112	2	.056	2.407	.102	.099
TIME* GROUP	.002	2	.001	.051	.950	.002
Error(TIMECA)	1.020	44	.023			

MEAN PROPORTION OF ADVANCED STRATEGIES BY GROUP AND TIME:

	Treatment Group "EXPERT"	Comparison Group "PEER"	All Participants
DIALOG 1:	.47 (.167)	.252 (.188)	.361 (.206)
DIALOG 2:	.524 (.111)	.332 (.148)	.428 (.161)
DIALOG 3:	.553 (.202)	.355 (.083)	.454 (.182)

(Standard Deviations are in Parentheses)

PROPORTIONAL USE OF ARGUMENT STRATEGY TYPES BY GROUP



Topic 4 - Individual Counterargument Strategies (A, C, U)

Proportional Means for Type of Counterargument (A, C, U) by Group and Time:

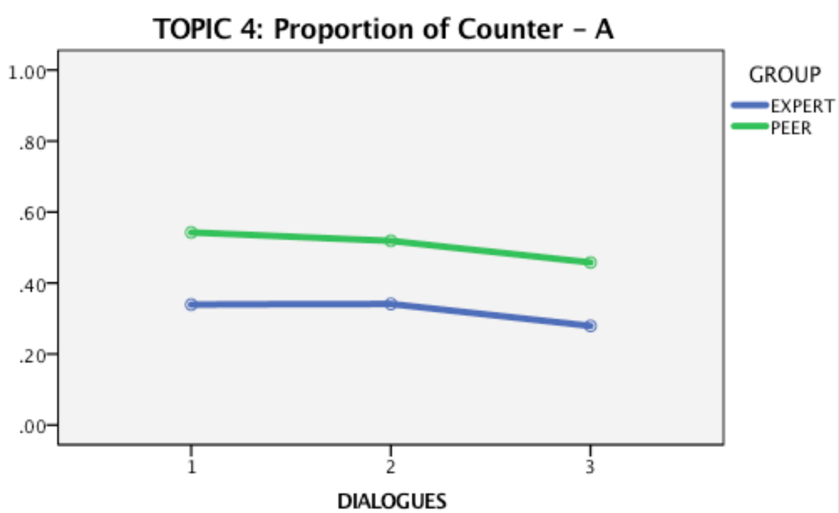
Counter- A		MEAN	STD DEV
T1 total		**0.441**	**0.209**
	expert	0.339	0.112
	peer	0.543	0.237
T2 total		**0.43**	**0.148**
	expert	0.341	0.128
	peer	0.519	0.11
T3 total		**0.369**	**0.209**
	expert	0.279	0.199
	peer	0.458	0.186

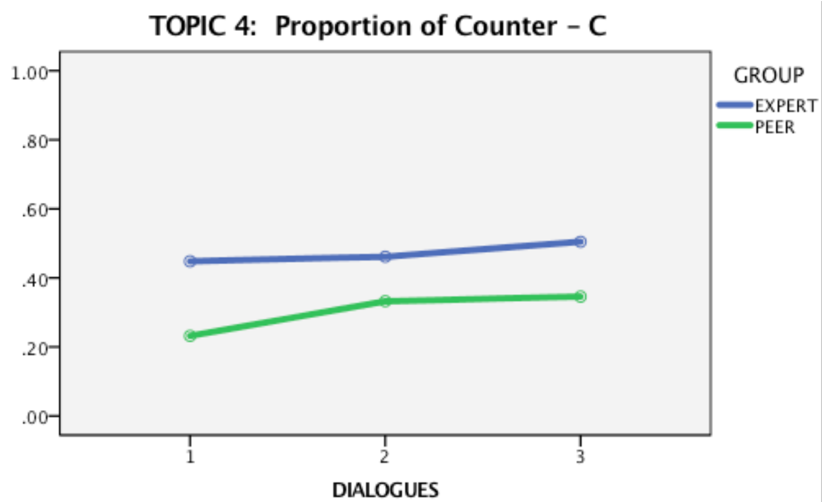
Counter- C		MEAN	STD DEV
T1 total		**0.34**	**0.192**
	expert	0.448	0.171
	peer	0.232	0.149
T2 total		**0.397**	**0.146**

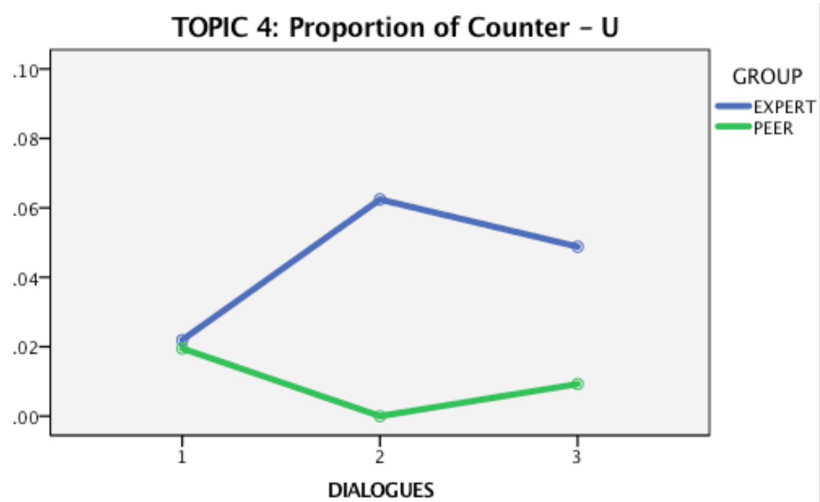
	expert	0.461	0.116
	peer	0.332	0.148
T3 total		**0.425**	**0.163**
	expert	0.505	0.188
	peer	0.346	0.078

Counter -U		**MEAN**	**STD DEV**
T1 total		**0.021**	**0.044**
	expert	0.022	0.042
	peer	0.02	0.047
T2 total		**0.031**	**0.076**
	expert	0.062	0.029
	peer	0	0
T3 total		**0.029**	**0.073**
	expert	0.049	0.096
	peer	0.009	0.032

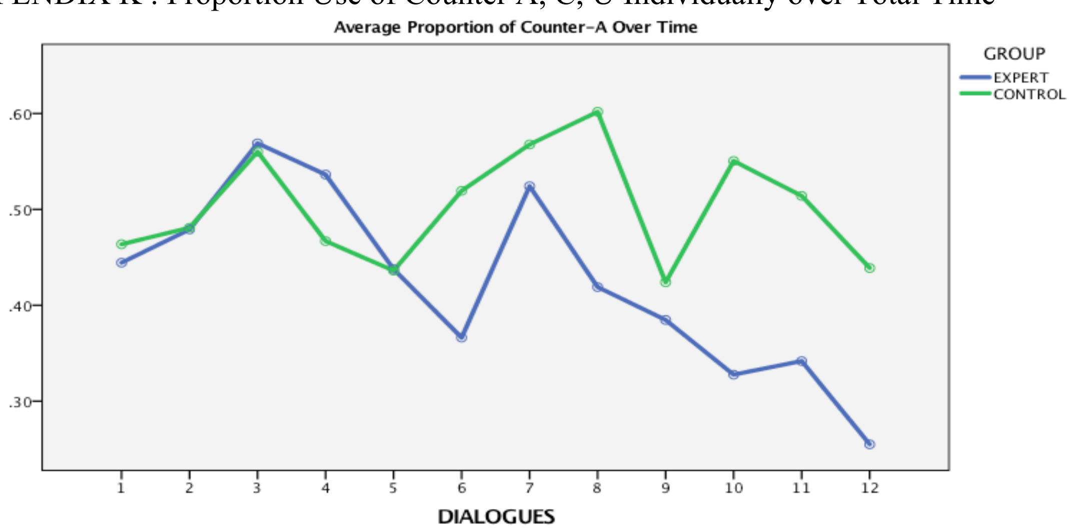
Topic 4- Proportion Use of Counter A, C, U Individually across Topic 4 Time Points

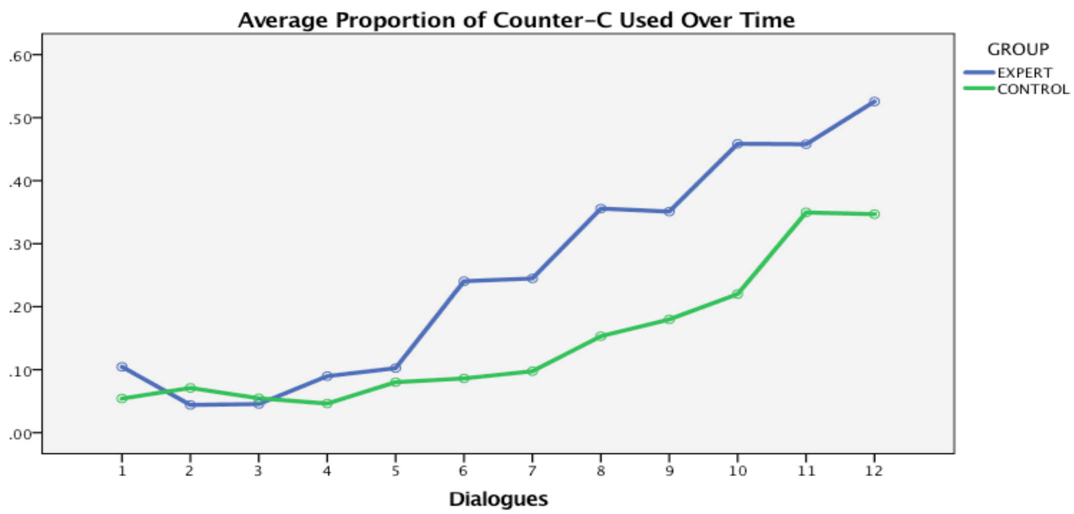


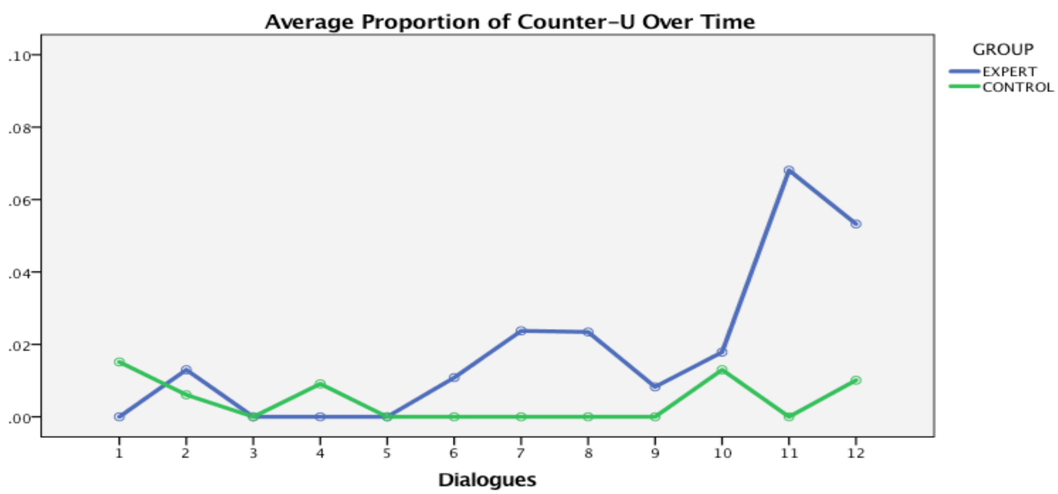




APPENDIX K : Proportion Use of Counter A, C, U Individually over Total Time







APPENDIX L: TRANSFER TASK – TABLES AND FIGURES

ANOVA

Source:	SS	df	MS	F	Sig.	Partial Eta Squared
BETWEEN	.305	1	.305	6.225	.017	.0132
WITHIN	2.010	41	.049			
Total	2.316	42				

MEAN PROPORTION OF ARGUMENT STRATEGIES BY GROUP AND TIME:

Counter- A	MEAN	STD DEV
Expert	0.377	0.219
Peer	0.556	0.226

Counter- C	MEAN	STD DEV
Expert	0.449	0.217
Peer	0.3	0.223

Counter -U	MEAN	STD DEV
Expert	0.073	0.111
Peer	0.53	0.127

PROPORTIONAL USE OF ARGUMENT STRATEGY TYPES BY GROUP